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EFFECTS OF DDT MOSQUITO LARVICIDING ON WILDLIFE

PART I. THE EFFECTS ON SURFACE ORGANISMS OF THE ROUTINE HAND APPLICATION OF DDT LARVICIDES FOR MOSQUITO CONTROL[1]

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This paper is the first of a series by the author and co-workers on the effects of DDT anopheline larviciding on wildlife. Subsequent parts dealing with other phases of the subject will appear at irregular intervals as the studies progress. Investigations of the effects on wildlife of the routine use of DDT as a mosquito larvicide were undertaken by the United States Public Health Service at the Carter Memorial Laboratory late in 1944. The purpose of these studies was to determine at what dosages and in what manner or physical state DDT could be routinely used as an anopheline larvicide without being significantly harmful to other organisms of economic or recreational value.

During the first year of the study, investigations were made on the effects of the routine hand application of DDT dusts, emulsions, and solutions. Experiments were carried on in 22 ponds, using several methods of application, types of larvicides, and dosages of DDT to determine their joint and individual effects on the fish life and the surface, bottom, and plankton organisms. DDT dusts were applied by means of several types of dusters, but air-pressure hand sprayers were generally used for the application of emulsions and solutions. DDT solutions were generally applied at the rate of ½ or 1 gallon per acre by means of an atomizing nozzle (*1*). It became apparent early in the study that tight emulsions and solutions applied at a rate of 0.4 pound, or more, of DDT per acre were detrimental to fish in shallow

[1] From Communicable Disease Center, Technical Development Division (Savannah, Ga.), States Relations Division.

water. Such methods and rates of application were therefore abandoned in favor of dusts or solutions applied at the rate of 0.1, 0.05 or 0.025 pound of DDT per acre. Individual treatments with these latter dosages caused no observed fish mortality. However, routine treatments at 0.1 pound per acre caused fish mortality between the third and tenth treatments. A series of 11 to 18 treatments at this rate significantly reduced the fish population in the ponds studied. Data secured to date indicate that, for small or shallow waters, routine treatments should not exceed 0.05 pound DDT per acre. Routine treatment at the rate of 0.05 pound per acre caused fish mortality in shallow ponds in which the entire area was treated. It is believed that in larger, deeper waters in which only the margins are treated, mortality will not be significant. Tests are to be made in such areas, using 0.05 pound of DDT routinely. No fish mortality was observed in areas routinely treated at 0.025 pound of DDT per acre.

During the second year (1945) of the investigation, emphasis was laid on a study of the effects of routine treatment at 0.1 pound DDT per acre, applied by airplane. Exhaust sprays or thermal aerosols and sprays from nozzles were the methods of application. Extensive areas on the Savannah River National Wildlife Refuge were treated in these studies. In addition to the effects on fish and fish food (surface, bottom, and plankton organisms), the investigations were expanded, in cooperation with the United States Fish and Wildlife Service, to include studies of the effects of routine treatment on amphibians, reptiles, birds, mammals, and terrestrial insects. Studies of these latter groups were confined to marginal areas into which there is driftage from treated areas.

During the third season, observations will be made in the Wildlife Refuge to determine the effects of 2 years of routine treatments on the fish population.

Investigations of the effects of the routine hand application of DDT mosquito larvicides on surface organisms other than mosquitoes were undertaken in April 1945. The purpose of these studies was to determine at what concentrations, and in what manner, DDT could be routinely used as an anopheline larvicide, without being significantly harmful to the surface organisms which are of importance as fish food and to wildlife in general. Experiments were conducted on more than 20 ponds, using several different formulae, methods of application, and concentrations of DDT.

PROCEDURE

All investigations were conducted on ponds in the vicinity of Savannah, Ga. Studies were made in three areas in the Savannah

River National Wildlife Refuge, on natural ponds, and on 14 artificial ponds at the Plant Introduction Laboratory of the Bureau of Plant Industry. Rotary hand dusters, atomizers, and air-pressure hand sprayers, equipped with several types of nozzles, were used for the application of the larvicidal materials. The larvicide was applied as a dust, a tight emulsion, a quick-breaking emulsion, and in solution. The forms most commonly used were a 1-percent-DDT dust in Electro FD No. 2 [2] and a solution of DDT in fuel oil, applied at the rate of 1 gallon or ½ gallon per acre. The dosages used varied from 2 pounds to 0.025 pound per acre, those most commonly used being 0.1 pound, 0.05 pound, and 0.025 pound per acre. Treatments were routine at weekly intervals.

Two methods were used for detecting kills or changes in the population of surface organisms due to the routine treatments. Gross observations were made 24 to 48 hours after treatment to detect any kill of the larger surface insect forms, such as Gyrinidae, Dytiscidae, Hydrophilidae and Corixidae, and quantitative surface samples were taken before and after treatment to determine any changes in the population of surface organisms due to individual treatments. During the first 2 to 4 weeks of treatment, quantitative samples were taken before and after each treatment, but thereafter they were taken at biweekly intervals. Samples were taken simultaneously in suitable check ponds.

Each surface sample represented the organisms from a surface area of 1 square foot to a depth of 2 inches. Thus, in taking each sample, about ⅙ cubic foot of water was strained. The samples were taken by means of the screen-dipper and strainer-pan technique, described by Hess and Tarzwell (*2*). This dipper (fig. 1) has a metal frame 4 inches square, a copper-wire-screen back and an adjustable handle. Since the dipper is 4 inches, or ⅓ foot, wide, pulling it over a distance of 3 feet sampled an area of 1 square foot, from which it strained out and retained all organisms larger than the wire-mesh openings. A mark was placed on the side of the dipper 2 inches above the bottom, so that all samples could be taken at the proper depth. The dipper was moved through the water at a slow uniform rate to allow all the water to pass through, while retaining the organisms. Water was collected in the strainer pan (fig. 2), and the contents of the dipper were washed into it by placing the back of the dipper in the water and then, by a backward motion, causing the water to pass through the screen in the reverse direction, thus washing the organisms out of the dipper and into the pan. The strainer pan was provided with the same mesh of screen as that on the dipper, so that

[2] Electro FD No. 2 is a specially treated calcium-carbonate dust, manufactured by Calcium Carbonate Co., Chicago, Ill.

water collected in it would be free of those organisms retained in the dipper. After the contents of the dipper were washed into the strainer pan, they were then poured through a concentrator (fig. 3) to remove excess water. After the solid materials were sufficiently concentrated, the plug was removed from the concentrator and the contents were washed into a suitable container, by means of a wash bottle, and preserved for study. In the laboratory, the organisms in each sample were identified and counted by means of a binocular dissecting microscope. Square petri dishes, the bottoms of which were marked off in a grid, each square of which was the size of the microscope field, were used in making the counts. Prepared forms were used for recording the organisms found in each sample. All data were analyzed statistically to determine the significance of any changes due to treatment.

At the beginning of the study, 25 random samples were taken in a selected area before and after treatment. It soon became apparent, however, that large homogeneous areas suitable for such sampling did not occur in the ponds being studied, and that there was great variation in the numbers of organisms found in the various samples. In most instances this variation was so great that it would have been impossible to detect even large differences due to treatment. Random sampling was therefore abandoned in favor of paired samples. A method of sampling was adopted wherein 10 sampling stations were set up in each of the principal ponds being studied. These stations were marked by numbered stakes, and the richest areas were selected for the stations to insure a large number and variety of organisms in each sample. The stakes were so placed that environmental conditions were as nearly similar as possible on all sides of the stake, for a distance of at least 1 yard. The pretreatment samples were taken on the right side of the stake just previous to the application of the larvicide, and the posttreatment samples were taken on the left, 48 hours thereafter. Before treatment began, the adequacy of the sampling method was tested by comparing samples taken on the right and left sides of the stakes 48 hours apart. Differences between samples taken in this manner without treatment were not significant, indicating that the sampling technique was adequate. Samples were taken before and after the first two treatments and then at biweekly intervals, or at every other treatment. A consistent effort was made to reduce variation by rigidly controlling the sampling technique, so that differences due to the treatment might be detected. Student's t test was used for comparing the samples to determine the significance of the differences, and P values were used to denote levels of significance, a value of 0.05 or less being considered significant.

The above methods were used for determining the effects of indi-

FIGURE 1.—Taking a square-foot surface sample with the screen dipper. A yardstick is used to insure accuracy in the distance sampled.

FIGURE 2.—Collecting water in the strainer pan.

FIGURE 3.—Pouring the contents of the strainer pan through the concentrator.

vidual treatments. Residual or accumulative effects due to routine treatment were shown by comparing graphically the populations in the treated and check ponds throughout the season, or throughout the period of treatment.

RESULTS AND CONCLUSIONS

Tight or stable emulsions, formed by some organic solvent such as xylene, DDT, an emulsifier, and water, were found to be detrimental to aquatic organisms when sprayed on the water. Tight emulsions, when applied at dosages of 0.2 pound of DDT per acre, killed many aquatic insects and fish. For this reason, they were abandoned in favor of quick-breaking emulsions or solutions of DDT containing a spreading agent. Water emulsions were also abandoned in favor of solutions of DDT in fuel oil or kerosene, applied at the rate of 1 gallon per acre, because of the savings in labor. Thus 1-percent -DDT dusts and solutions of DDT in fuel oil with a spreader were used in most of the tests to determine the effects of DDT on the aquatic biota other than mosquitoes.

GROSS OBSERVATIONS

Gross observations were made at the time of treatment, and 24 and 48 hours after treatment, to note any kill of the larger forms. In shallow ponds having a sand bottom, individual treatments with fuel-oil solutions, at rates of 1 to 2 pounds of DDT per acre, killed aquatic hemipterons, beetles, dragonflies, damselflies, mayflies, chironomids, tadpoles, crayfish, and fish. Treatment with oil solutions, at dosages of 0.4 pound of DDT per acre also killed many of the aquatic forms, but a single treatment at this rate did not kill fish.

Treatments in all routine studies with fuel-oil and kerosene solutions of DDT were at dosages of 0.1, 0.05, and 0.025 pound per acre. Dusts were generally applied at the rate of 0.1 pound DDT per acre. Little or no kill was noted after individual and routine treatments with dust. From information now at hand, it appears that routine treatments with DDT dusts, in quantities sufficient to give adequate anopheline control, are not harmful to wildlife. Individual treatments with DDT solutions in fuel oil, applied at the rate of 1 or ½ gallon per acre and at the above dosages, gave kills of the following forms: Collembola, Corixidae, Notonectidae, Belostomatidae, Naucoridae, Gerridae, Haliplidae, Dytiscidae, Gyrinidae, Hydrophilidae, and Chironomidae. In general, the kills were more pronounced for the larger dosages. There were distinct kills at all dosages after several treatments, but for the first few treatments, very slight mortalities were noted at dosages of 0.025 pound of DDT per acre. The first treatment at 0.1 pound of DDT per acre gave significant kills of the larger

surface insects, and pronounced kills resulted from the second treatment, after which the observed number of dead organisms decreased. This was probably due to a marked reduction in the population due to the first two treatments. Surface forms were not eliminated, however, even by a series of 22 weekly treatments at 0.1 pound of DDT per acre.

Counts of the kill of surface organisms in a series of ponds 24 hours after the eleventh, twelfth and fourteenth treatments clearly show that surface forms were present in considerable abundance after routine treatments extending over a three-month period. The kill of the various forms in these ponds 24 hours after the eleventh, twelfth and fourteenth treatments are tabulated in table 1. These ponds were all about the same size, 5 by 15 feet. As indicated in table 1, a considerable number of aquatic and terrestrial forms were found dead in the ponds. It is probable that the terrestrial forms had been resting near the ponds and were killed at the time the ponds were treated, or that they later came in contact with the oil film containing the DDT. The latter is true for the Orthoptera, and the various adult Diptera and Odonata. The dragonfly and damselfly nymphs were very resistant to the DDT solutions sprayed on the surface of the ponds, but the adults were susceptible, and were killed in considerable numbers. A portion of these probably came to the water surface to lay eggs. In treatment of extensive areas, this kill might become important.

Dead adult chironomids were found on the water surface in great numbers, many of which were probably killed while attempting to emerge. In several instances, they were present in such large numbers that it was impractical to count them. In the counts made on these ponds, dead dytiscids and hydrophilids ranked next in abundance after chironomids. In the ponds treated at the rate of 0.1 pound of DDT per acre, the average kill per treatment, exclusive of chironomids, was 113 organisms, or 1.5 per square foot; in the ponds treated at the rate of 0.05 pound DDT per acre it was 10 organisms, or 0.13 per square foot; and in those treated at the rate of 0.025 pound per acre, the average kill was 35 organisms, or about 0.5 per square foot. Treatment with fuel oil alone, at the rate of 1 gallon per acre, resulted in an average kill for the three treatments of 12 organisms, exclusive of chironomids. The average number of dead insects found in the dusted pond was five, whereas the average for the check ponds was slightly more than two. These results indicate that treatment with dust at the rate of 0.1 pound of DDT per acre kills very few surface insects. The over-all results suggest that 0.05 pound and 0.025 pound of DDT per acre in fuel oil kills only a fraction as many surface forms as do applications at 0.1 pound per acre, and that fuel oil in itself kills numerous forms. It may be that 0.025 to 0.05 pound of DDT applied

TABLE 1.—*Summary of the kill of large surface and other organisms in 14 experimental ponds due to th*

Organism	DDT in No. 2 fuel oil applied at the rate of ½ or 1 gallon per acre																							Fue
	0.1 pound DDT per acre									0.05 pound DDT per acre						0.025 pound DDT per acre								1 gallo ac
	Pond 1			Pond 8			Pond 17			Pond 13			Pond 16			Pond 7			Pond 14			Pond 15			Pon
	Treatment No.																							
	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	1
Diplopoda			3																							
Collembola	2	1																1			1					
Orthoptera	1	1	2		1	2				1											1					
Ephemeroptera		12	8	1				9	5				1	1	1		4			2					1	
Corixidae	2	10	2		2	1		9	2									3			1					
Notonectidae	1	5	7					1	4			1						1								
Belostomatidae																										
Naucoridae								3	2			1														
Veliidae																										
Gerridae								1																		
Miridae			2	1																	1					
Lygaeidae		1																		1						
Saldidae					1												1									
Cercopidae	2	1	2					2																		
Cicadellidae		4	2	3	1		1		1							2	1	2	1		2					
Fulgoridae		1							1						2			5								
Aphididae											1															
Anisoptera	4		2	2			4	2	1		1	1	1		1	1			3	1		3			1	
Zygoptera	2					3	5	2	8							2	1	3	1	1	1	2		1		
Carabidae								1																		
Haliplidae		1						9																		
Dytiscidae	11	124	35	4	40	9	8	190	76	1	7	4	1	10	3	2	27	15	7	17	4	3	9	7	1	
Gryinidae			1																					1		
Hydrophilidae	9	62	12	3	27	8	7	56	21	1	1	2	1	3	1	13	16	8		17	4		3		1	
Staphylinidae	1		3													3										
Meloidae																										
Helodidae								1																		
Scarabaeidae					1				1																	
Curculionidae																										
Ptilodactylidae		2																								
Tipulidae	1		3	1				2									2	1								
Anisopidae					1											2										
Chironomidae	13	(1)	(1)	13	(1)	(1)	5	(1)	(1)		1	2	1	1	5	5	(2)	(2)	6	21	28	1	6		3	(2)
Culicidae																										
Bibionidae		2																								
Mycetophilidae																	1									
Tabanidae										1		1														
Stratiomyiidae									1																	
Dolichopodidae		3	1		3	5		1		1	1						4	2	1	2	2			1		
Acalyptrate Diptera		23	11	4	6	10	1	1	7	1		1			1	3	9	23	8	3	4			1		
Syrphidae	2																									
Calyptrate Diptera																										
Anthomyiids	1	1																								
Muscoids	3	3						1	1							2				1					1	
Calliphoridae			1	1																						
Sarcophagidae																					1					
Lepidoptera		1					3		2				1		2							2		1		
Formicidae		3																	1							
Vespidae																			1							
Apidae								1	1	1									1							
Arachnida		6	7		1	6	1		2	1		2				5	8	5	1	3	3	1			1	
Totals less Chironomidae	42	267	104	20	84	44	30	292	136	8	11	13	5	14	11	35	74	69	25	48	25	11	12	12	6	1
Average kills per pond per treatment					113						10									35						1

[1] Too numerous to count.
[2] Many.

ental ponds due to the use of DDT larvicides at specified dosages and times

				Fuel oil			Dust						None									
DT per acre				1 gallon per acre			0.1 pound DDT per acre						Check ponds									
14	Pond 15			Pond 6			Pond 2			Pond 12			Pond 5			Pond 10			Pond 11			Totals
eatment No.																						
14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	11	12	14	
																						3
1																						5
1																						9
				1	3									3								51
1					1																	33
													1									20
																						1
						1																6
																						1
1																						1
																						4
																						2
																						2
2						1							1									7
																						22
						2																9
	3			1			1	1					1	1								3
1	2		1										1	3	2							32
									1													38
																						2
4	3	9	7	1	3	1	2	2	4	1		1	2		1				1	1		10
			1																			634
4		3		1	3	1	1	1	4	1					1							2
																						288
																			1			7
																						1
																						1
												1										2
																						1
					1		1		1													2
																						13
28	1	6		3	(2)	14			1			1		6	20	1		1				3
									1													155+
																						1
																						2
																						1
																						2
2			1																			1
4			1			6									1							27
																						124
						2																2
																						2
				1	1										1							2
1																						14
	2		1																			2
						1			1													1
																						12
																						6
3	1			1	3				2													1
																						4
25	11	12	12	6	15	15	5	4	14	2	0	2	6	7	6	0	0	0	2	1	0	58
																						1,477
					12				4.5								2.4					

in 1 gallon of fuel oil per acre will kill considerably less insect life than the regular routine oiling at 15 to 40 gallons per acre which has been used for mosquito control in the past.

The surface forms found dead in the treated and check ponds at the Wildlife Refuge after the eighteenth treatment are summarized in table 2. These results also indicate that oil solutions cause a con-

TABLE 2.—*Summary of the kill of surface forms by the eighteenth routine larvicidal treatment at the Wildlife Refuge*

Organism	Pond 1 DDT in fuel oil—0.05 pound per acre Eighteenth treatment	Pond 2 DDT dust—0.1 pound per acre Eighteenth treatment	Pond 3 No treatment—Check Eighteenth treatment	Organism	Pond 1 DDT in fuel oil—0.05 pound per acre Eighteenth treatment	Pond 2 DDT dust 0.1—pound per acre Eighteenth treatment	Pond 3 No treatment—Check Eighteenth treatment
Diplopoda				Ptilodactylidae			
Collembola				Tipulidae			
Orthoptera				Anisopidae			
Ephemeroptera				Chironomidae	(1)		
Corixidae	219	2		Culicidae			
Notonectidae				Bibionidae			
Belostomatidae				Mycetophilidae			
Nepidae	1			Tabanidae			
Veliidae	1			Stratiomyiidae			
Gerridae				Dolichopodidae	1		
Miridae				Acalyptrate Diptera	2		
Lygaeidae	3			Syrphidae			
Saldidae				Calyptrate Diptera			
Cercopidae				Anthomyiids			
Cicadellidae		1		Muscoids			
Fulgoridae				Calliphoridae			
Aphididae	1			Sarcophagidae	1		
Anisoptera				Sciaridae			
Zygoptera	5			Empididae			
Carabidae				Trypetidae			
Haliplidae	5			Lepidoptera	2		
Dytiscidae	77	2		Trichoptera	4		
Gyrinidae				Vespidae			
Hydrophilidae	3			Apidae			
Staphylinidae				Chalcididae	1		
Meloidae				Arachnida	3		
Helodidae							
Scarabaeidae				Totals	329	5	0
Curculionidae							

[1] Too numerous to count.

siderable kill, whereas the dust has little effect. They further indicate that although each treatment kills a considerable number of surface forms, it does not exterminate them, for there was a marked kill after the eighteenth treatment. The apparently large kill at 0.05 pound of DDT per acre in the refuge pond is due to the fact that this pond is many times larger than those dealt with in table 1.

The mortalities of organisms noted after the fifth and seventh treatments on three ponds in the Camp Stewart area are tabulated in table 3. Average mortalities per treatment were 258 organisms for 0.1 pound DDT per acre and 81 organisms for 0.05 pound. Two dead

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TABLE 3.—*Kill of surface organisms 24 hours after the routine fifth and seventh treatments in experimental ponds at Camp Stewart*

Organism	Check—No treatment		DDT in kerosene			
			0.1 pound DDT		0.05 pound DDT	
	Pond 11		Pond 12		Pond 13	
	Treatment No.		Treatment No.		Treatment No.	
	5	7	5	7	5	7
Ephemeroptera			3	11		2
Corixidae			4	32		6
Notonectidae				1	1	
Belostomatidae			3		2	
Gerridae			1	1		
Miridae				3		1
Cercopidae				2		2
Cicadellidae				2		
Fulgoridae				4		
Aphididae				1		1
Anisoptera		3	2	16		3
Zygoptera				31		1
Dytiscidae			135	107	72	23
Gyrinidae			106	16	13	2
Hydrophilidae			18	5	15	10
Tipulidae				1		1
Chironomidae		1	(1)	(2)	(3)	3
Stratiomyiidae				1		
Acalyptrate Diptera						2
Sciaridae				1		
Empididae				1		
Trypetidae						1
Lepidoptera				2		
Trichoptera				4		
Formicidae						1
Arachnida				1		
Totals less Chironomidae	0	3	272	243	103	56

[1] Many.
[2] Too numerous to count.
[3] A few.

organisms were found in the check pond. Forms most prominent in the kill were the same as those found in the other ponds, namely, Dytiscidae, Gyrinidae, Hydrophilidae, Corixidae, and adult Anisoptera and Zygoptera.

Several series of studies were made to determine the relative effect of various solvents when used alone. It was found that kerosene was less toxic than fuel oil and that alcohol, acetone, and Aro-sol [3] killed very few insects. However, when combined with DDT, which is much more toxic than any of the solvents tested, indications are that the effect of the solvent is masked and that mortalities resulting from the various DDT solutions do not differ significantly. This phase of the problem needs more study, especially on those solvents which evaporate quickly, or which may affect final distribution of the DDT. When used alone, at the rate of 2 gallons per acre, fuel oil and Velsicol NR–70 [4]

[3] Aro-sol is a methylated naphthalene product of the Sun Oil Co., Philadelphia, Pa.
[4] Velsicol NR-70 is a tetramethyl naphthalene manufactured by the Velsicol Corp. of Chicago, Ill.

caused a considerable kill of surface insects. Velsicol gave a distinct scumlike film and was the most toxic solvent tested.

QUANTITATIVE SURFACE SAMPLES

Square-foot surface samples were taken in a number of treated and check ponds to determine the effect of individual treatments with DDT larvicides on surface organisms. In each group or series of ponds, samples were taken from both treated and check ponds on the same day so that conditions would be comparable. Thus, for each series of samples taken before and after treatment from the sprayed areas, similar series were taken from the check area, with the usual 48-hour interval between samplings. Both permanent and temporary watered areas were studied in this manner.

Test ponds 1, 2, and 3 were permanent water areas at the Savannah Migratory Waterfowl Refuge. Pond 1 was routinely treated with a DDT-fuel-oil solution at the rate of 0.05 pound of DDT and 1 gallon of fuel oil per acre. Pond 2 was dusted at the rate of 0.1 pound of DDT per acre, and pond 3 was an untreated check for the other two ponds. The DDT-fuel-oil solution proved much more toxic to the surface Hemiptera and Coleoptera than the DDT-pyrophyllite dust mixture. Changes in the population of surface organisms in pond 1, due to the individual applications, as indicated by the 190 quantitative surface samples taken during the period of treatment, are summarized in table 4. Samples were taken before and after the first, second, fourth, sixth, eighth, tenth, eleventh, thirteenth, and fifteenth treatments, and after the seventeenth in each of the ponds. The total number of the various organisms found in the 10 samples taken before and after the indicated treatments are shown in table 4, as well as the mean difference of the number taken before and after treatment. A decrease in the number of organisms found after treatment is indicated by a minus sign, and a significant change by an asterisk. Few significant changes were noted in the population of surface organisms due to individual treatments, and most of those which did occur were not consistent.

Pond 2 was treated with a 1-percent-DDT dust in pyrophyllite at the rate of 0.1 pound of DDT per acre, but demonstrated less damage than pond 1, treated with 0.05 pound of DDT in fuel oil. A total of 190 square-foot surface samples were taken in this pond. The organisms taken in these samples are tabulated in table 5. Only one significant decrease in the total number of organisms was found. Changes in the numbers of organisms in the different groups were not consistent and are therefore not considered important.

The check pond, number 3, showed two significant changes in the total number of organisms found. The samples collected on Sep-

TABLE 4.—*Changes in the population of surface organisms in test pond 1, due to routine weekly treatments at the rate of 0.05 pound of DDT and 1 gallon of fuel oil per acre, as indicated by quantitative square-foot surface samples taken just before, and 48 hours after, designated treatments*

Organism	First treatment (July 7, 1945)			Second treatment (July 17, 1945)			Fourth treatment (July 31, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	0	2	[2]	17	31		4	4	
Turbellaria	2	0		23	20		6	2	
Nematoda	2,418	2,613	19.5± 99	2,380	3,346	96.6± 53.0	2,949	2,479	−47.0± 50.3
Rotatoria	98	97		180	292	11.2± 8.4	137	86	−5.1± 3.4
Bryozoa	0	0		0	0		0	0	
Oligochaeta	348	147	[1] −20.1± 7	663	766	10.3± 19.5	2,469	2,327	−14.2± 65.3
Hirudinea	1	0		1	3		0	0	
Cladocera	1,158	1,174	1.6± 19	1,703	2,073	37.0± 70.0	2,610	469	[2] −214.1± 62.2
Copepoda	930	1,018	8.8± 13	1,114	1,391	27.7± 30.0	1,236	639	[1] − 59.7± 21.8
Ostracoda	1,161	1,056	−10.5± 41	842	1,182	34.0± 22.3	915	543	−37.2± 20.6
Amphipoda	4	0		6	2		0	1	
Isopoda	0	2		2	4		0	0	
Palaemonetes	0	0		0	0		0	0	
Hydracarina	64	66		38	90	5.2± 2.8	63	14	[1] −4.9± 1.7
Collembola	0	8		3	2		0	4	
Ephemeroptera	19	19		26	43	1.7± 1.6	26	10	−1.6± .8
Anisoptera	8	6		5	17	[1] 1.2± .5	8	9	
Zygoptera	9	12		10	21	1.1± .8	14	11	
Hemiptera	17	8		7	5		5	6	
Coleoptera	6	3		9	12		10	1	[1] −.9± .4
Trichoptera	13	7		13	16		7	2	
Lepidoptera	5	6		2	2		0	1	
Culicini	0	0		2	0		0	0	
Anopheles	0	0		0	0		0	0	
Chironomidae	214	179	−3.5± 6.4	106	98	−.8± 2.9	158	90	−6.8± 11.6
Other Diptera	5	8		1	4		3	12	.9± 1.0
Gastropoda	3	4		1	3		4	3	
Total	6,483	6,435	−4.8±163	7,154	9,423	226.9±139.0	10,624	6,713	−391.0±189.3

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

TABLE 4.—*Changes in the population of surface organisms in test pond 1, due to routine weekly treatments at the rate of 0.05 pound of DDT and 1 gallon of fuel oil per acre, as indicated by quantitative square-foot surface samples taken just before, and 48 hours after, designated treatments*—Continued

Organism	Sixth treatment (Aug. 14, 1945)			Eighth treatment (Aug. 29, 1945)			Tenth treatment (Sept. 11, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	10	13		8	12		3	6	
Turbellaria	2	3		11	6		22	14	
Nematoda	5,358	5,850	49.2±172.3	9,275	7,396	−187.9±188.1	[3]	[3]	
Rotatoria	275	228	−4.7± 9.0	148	211	6.3± 3.9	124	105	−1.9± 4.1
Bryozoa									
Oligochaeta	6,200	6,564	36.4±276.6	5,496	3,854	−164.2±139.0	10,001	4,467	−553.4±308.3
Hirudinea									
Cladocera	1,910	4,511	[2] 260.1± 56.2	4,550	4,666	11.6± 65.8	3,553	2,109	−144.4± 97.7
Copepoda	1,922	3,038	[2] 111.6± 28.4	2,065	3,183	[1] 111.8± 47.4	2,427	1,655	−77.2± 80.8
Ostracoda	328	317	−1.1± 5.9	212	251	3.9± 5.0	327	152	−17.5± 9.0
Amphipoda									
Isopoda	3	1							
Palaemonetes									
Hydracarina	20	31		103	116	1.3± 3.7	452	262	−19.0± 8.6
Collembola	5	2		33	22	−1.1± 1.5	2	0	
Ephemeroptera	11	10		34	28	−.6± 1.1	101	31	−7.0± 5.3
Anisoptera	21	21		51	28	−2.3± 1.3	62	22	[1] −4.0± 1.7
Zygoptera	9	19	1.0± .6	30	19	−1.1± 1.4	19	13	
Hemiptera	4	2		5	2		3	0	
Coleoptera	4	4		14	5	−.9± .5	11	4	
Trichoptera	1	1							
Lepidoptera				0	1				
Culicini				1	1		1	0	
Anopheles									
Chironomidae	20	38	1.8± 1.6	281	286		751	216	−53.5± 25.1
Other Diptera	1	6		25	27		299	193	−10.6± 9.2
Gastropoda	3	9		6	4		1	0	
Totals	16,107	20,668	456.1±480.5	22,348	20,118	−223.0±351.0	18,159	9,249	−891.0±499.0

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

[3] Not counted.

TABLE 4.—*Changes in the population of surface organisms in test pond 1, due to routine weekly treatments at the rate of 0.05 pound of DDT and 1 gallon of fuel oil per acre, as indicated by quantitative square-foot surface samples taken just before, and 48 hours after, designated treatments*—Continued

Organism	Eleventh treatment (Sept. 18, 1945)			Thirteenth treatment (Oct. 3, 1945)			Fifteenth treatment (Oct. 17, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	14	15		19	25		17	9	−0.8± 0.9
Turbellaria	19	23	0.4± 1.6	11	11		16	0	−1.6± 1.1
Nematoda	(3)	(3)		(3)	(3)		(3)	(3)	
Rotatoria	71	121	5.0± 2.9	108	71	−3.7± 3.6	10	6	
Bryozoa									
Oligochaeta	3,391	5,683	229.2±188.4	2,014	3,577	156.3±103.0	4,814	858	−395.6±223.2
Hirudinea									
Cladocera	1,275	2,900	162.5± 78.1	1,728	2,262	53.4± 50.3	1,321	676	[1]−64.5± 26.4
Copepoda	1,044	3,081	203.7± 80.3	1,682	2,657	[1] 97.5± 39.9	2,508	1,297	[2]−121.1± 36.0
Ostracoda	387	527	14.0± 18.6	586	419	−16.7± 18.4	330	112	[1]−21.8± 8.5
Amphipoda									
Isopoda									
Palaemonetes									
Hydracarina	82	231	14.9± 7.8	108	198	9.0± 4.5	170	194	2.4± 2.6
Collembola	8	22	1.4± 1.4	19	21		2	6	
Ephemeroptera	142	147	.5± 5.6	222	128	−9.4± 6.9	63	13	−5.0± 2.3
Anisoptera	52	46	−.6± 2.9	26	49	2.3± 1.8	34	7	−2.7± 1.8
Zygoptera	6	39	3.3± 3.4	31	38		22	5	−1.7± .8
Hemiptera	3	5		2	5		0	1	
Coleoptera	22	19	−.3± 4.4	11	7		6	2	
Trichoptera				0	1				
Lepidoptera	1	1							
Culicini									
Anopheles				1	0				
Chironomidae	246	274	2.8± 10.7	199	203		42	22	−2.0± 1.8
Other Diptera	361	327	−3.4± 9.2	55	66		27	11	−1.6± .9
Gastropoda	12	6	−.6± .5	0	3		14	9	
Total	7,136	13,467	633.1±358.5	6,822	9,741	291.9±179.2	9,396	3,228	[1]−616.8±258.4

[1] Exceeds 5-percent level of significance. [2] Exceeds 1-percent level of significance. [3] Not counted.

TABLE 5.—*Changes in the population of surface organisms in pond 2, due to routine weekly dusting with DDT at the rate of 0.1 pound per acre as indicated by quantitative surface samples taken just before, and 48 hours after, alternate treatments*

Organism	First treatment (July 9, 1945)			Second treatment (July 17, 1945)			Fourth treatment (July 31, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	4	10		57	62		2	5	
Turbellaria	1	15	1.4± 0.9	17	39	2.2± 2.5	11	16	
Nematoda	1,133	1,268	13.5± 82.0	1,298	1,820	52.2± 58.0	1,625	1,921	29.6± 45.7
Rotatoria	148	203	5.5± 7.2	235	414	17.9± 11.0	218	112	−10.6± 7.3
Oligochaeta	95	255	16.0± 13.8	483	571	8.8± 14.5	2,188	1,442	−74.6±115.4
Hirudinea	0	0		3	2		1	0	
Cladocera	784	735	−4.9± 20.4	836	760	−7.6± 24.0	1,052	1,588	[1] 53.6± 21.4
Copepoda	545	515	−3.0± 15.3	474	582	10.8± 10.0	710	349	−36.1± 22.5
Ostracoda	709	727		1,200	1,443	24.3± 64.0	1,148	743	−40.5± 25.2
Amphipoda	3	5		5	4		2	3	
Palaemonetes	1	0					2	0	
Hydracarina	372	19	−35.3± 16.8	52	47	−.5± 2.0	28	69	[1] 4.1± 1.4
Collembola	19	5	−1.4± 1.3	2	2		13	13	
Ephemeroptera	18	26		22	26		48	60	1.2± .9
Anisoptera	3	10	.7± .5	4	0		5	6	
Zygoptera	8	4		14	8		14	10	
Hemiptera	16	17		7	7		6	15	
Coleoptera	5	7		10	9		32	23	
Trichoptera	11	12		3	6		1	5	
Lepidoptera	4	5		2	2		0	2	
Culicini	0	0		0	0		1	3	
Chironomidae	73	67		73	49	−2.4± 1.5	69	112	4.3± 3.2
Other Diptera	4	11		5	2		8	8	
Gastropoda	2	0		1	0		4	3	
Total	3,958	3,916	−4.2±127.0	4,803	5,855	105.2±146.0	7,188	6,508	−68.0±174.3

[1] Exceeds 5-percent level of significance.

TABLE 5.—*Changes in the population of surface organisms in pond 2, due to routine weekly dusting with DDT at the rate of 0.1 pound per acre as indicated by quantitative surface samples taken just before, and 48 hours after, alternate treatments*—Continued

Organism	Sixth treatment (Aug. 14, 1945)			Eighth treatment (Aug. 29, 1945)			Tenth treatment (Sept. 11, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	13	14		5	5		11	8	
Turbellaria	25	2	[1]−2.3± 0.9	41	7	[1]−3.4± 1.5	23	20	
Nematoda	6,660	2,641	[1]−401.9±178.1	Not counted			Not counted.		
Rotatoria	409	107	−30.2± 23.0	471	289	[1]−18.2± 7.9	56	26	−3.0± 2.0
Oligochaeta	6,071	3,127	[1]−294.4±105.0	8,243	3,836	−440.7±209.1	5,963	2,701	[1]−326.2±139.7
Hirudinea	0	0		0	0		4	0	
Cladocera	3,848	1,597	[2]−225.1± 62.5	4,598	3,777	−82.1± 80.9	2,426	1,463	−96.3± 70.4
Copepoda	1,078	855	−22.3± 13.6	1,332	1,114	[1]−21.8± 8.4	843	830	−1.3± 12.9
Ostracoda	296	182	−11.4± 8.4	152	239	8.7± 4.9	647	326	−32.1± 24.7
Isopoda	1	0		0	0		0	0	
Palaemonetes	1	0		0	0		0	0	
Hydracarina	95	25	[1]−7.0± 2.8	65	42	−2.3± 1.8	189	167	−2.2± 5.4
Collembola	26	12	−1.4± 1.1	14	61	4.7± 3.2	2	6	
Ephemeroptera	89	31	[1]−5.8± 2.2	25	41	1.6± 1.7	109	47	−6.2± 4.3
Anisoptera	13	14		28	23		23	14	−0.9± .5
Zygoptera	13	10		23	9	−1.4± .7	13	16	
Hemiptera	7	6		6	6		15	11	
Coleoptera	28	19		40	14	−2.6± 1.3	56	40	−1.6± 1.1
Trichoptera	4	0		1	0		1	1	
Lepidoptera	3	2		1	16	[1]1.5± .5	0	1	
Culicini	4	0		2	0		2	1	
Anopheles	0	0		0	2		2	0	
Chironomidae	314	181	−13.3± 8.2	898	572	−32.6± 25.9	850	735	−11.5± 23.3
Other Diptera	32	14		33	55	2.2± 2.1	190	467	27.7± 25.5
Gastropoda	2	6		3	1		2	1	
Total	19,032	8,845	[1]−1,018.7±317.0	15,981	10,109	−587.2±263.9	11,427	6,881	[1]−454.6±195.4

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

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TABLE 5.—*Changes in the population of surface organisms in pond 2, due to routine weekly dusting with DDT at the rate of 0.1 pound per acre as indicated by quantitative surface samples taken just before, and 48 hours after, alternate treatments*—Continued

Organism	Eleventh treatment (Sept. 18, 1945)			Thirteenth treatment (Oct. 4, 1945)			Fifteenth treatment (Oct. 17, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	29	29		69	18	[1] −5.1± 1.7	12	2	−1.0± 0.6
Turbellaria	52	63	1.1± 3.2	93	21	−7.2± 3.7	21	1	−2.0± 1.4
Nematoda	Not counted			Not counted			Not counted		
Rotatoria	11	37	2.6± 1.6	138	168	3.0± 9.2	25	18	
Bryozoa	1	0		0	0		0	0	
Oligochaeta	1,864	2,034	17.0± 91.4	2,987	953	[1] 203.4± 74.8	2,357	294	−206.3±108.2
Cladocera	673	1,234	56.1± 27.5	2,377	2,117	−26.0± 37.9	990	357	[1] −63.3± 20.6
Copepoda	649	1,255	[2] 60.6± 13.6	1,185	1,891	70.6± 40.4	1,456	987	−46.9± 30.6
Ostracoda	248	410	16.2± 10.0	920	856	−6.4± 28.4	468	132	−33.6± 15.4
Hydracarina	54	109	[1] 5.5± 1.8	99	279	[2] 18.0± 4.8	277	187	−9.0± 6.7
Collembola	7	24	1.7± 1.0	53	75	2.2± 2.7	96	297	20.1± 9.5
Ephemeroptera	81	106	2.5± 3.8	465	190	−27.5± 16.4	140	42	−9.8± 6.0
Anisoptera	19	38	1.9± 1.1	21	23		10	10	
Zygoptera	3	13	1.0± .6	18	14		6	2	
Hemiptera	13	5		5	6		2	0	
Coleoptera	39	133	9.4± 7.2	79	38	−4.1± 2.7	46	18	−2.8± 2.1
Trichoptera	0	1		1	0		2	0	
Lepidoptera	2	0		4	0		0	0	
Culicini	0	0		1	0		0	0	
Chironomidae	490	458	−3.2± 24.3	679	363	−31.6± 19.7	143	193	5.0± 17.3
Other Diptera	218	287	6.9± 15.3	122	46	−7.6± 3.9	23	5	−1.8± 1.3
Gastropoda	5	21	1.6± 1.5	41	12	−2.9± 1.9	5	4	
Total	4,458	6,257	179.9±166.9	9,357	7,070	−228.7±205.3	6,079	2,549	−353.0±170.9

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

tember 20 showed an increase, whereas those collected on October 19 showed a decrease. Significant changes in the various groups of organisms were not consistent and may be largely due to sampling error. In general, the population in the check area followed what appeared to be a fairly normal seasonal trend (table 6). The 570 surface samples taken before and after individual treatments in the three ponds, throughout a series of 18 applications, indicate very little significant change in the population of surface organisms due to individual larvicidal treatments with DDT. A comparison of the data in tables 4, 5, and 6 shows no consistent change due to the individual treatments.

Some accumulative or seasonal changes in the population of the various groups of surface organisms were indicated by these studies. The seasonal trend of the total population of the surface organisms and of various groups of organisms in the treated ponds are compared with those in the check pond in figures 4 through 8. These graphs show the average number of organisms per square-foot sample from each of the three ponds at each sampling date. Figure 4 shows the

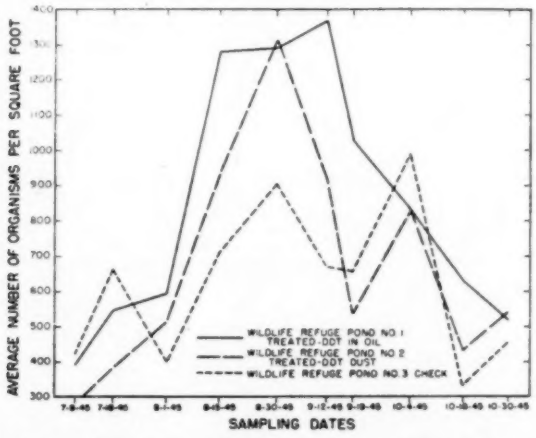

FIGURE 4.—A seasonal comparison of the population of surface organisms in an untreated pond with those in ponds routinely treated with DDT larvicides for 17 weeks. Pond 1 treated at the rate of 1 gallon fuel oil and 0.05 pound of DDT per acre, pond 2 dusted at the rate of 0.1 pound of DDT per acre, and pond 3 untreated. Graph based on 570 quantitative square-foot surface samples taken to a depth of 2 inches.

average number of all organisms per square foot found in each pond throughout the season. This graph indicates an increase in the total number of surface organisms in the treated ponds, with the greatest increase occurring in the pond treated with the DDT-oil solution.

Figure 5 shows the seasonal abundance of Cladocera in the check and treated ponds. Although the average number of Cladocera per square foot was somewhat greater in the treated ponds, it is not believed that the differences are significant. On the whole, the Cladocera

TABLE 6.—*Changes in the population of surface organisms in pond 3, the check for treated ponds 1 and 2, due to seasonal variation and errors in sampling as indicated by paired surface samples taken at intervals of 48 hours in alternate weeks*

Organism	First treatment (July 9–11, 1945)			Second treatment (July 17–19, 1945)			Fourth treatment (July 31–Aug. 2, 1945)		
	Number of paired samples								
	10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	3	3		46	49		0	0	
Turbellaria	0	1		13	7		9	0	
Nematoda	926	876	−5.0± 43.1	1,637	1,409	−22.8± 79.0	988	1,775	78.7± 42.9
Rotatoria	618	468	−15.0± 17.0	108	183	7.5± 9.0	96	39	−5.7± 2.9
Oligochaeta	514	231	−28.3± 28.3	744	938	19.4± 68.0	739	1,279	54.0± 35.2
Hirudinea	1	0		3	0		0	0	
Cladocera	930	1,074	14.4± 38.9	2,341	1,560	−78.1± 78.0	1,076	628	[1] −44.8± 13.2
Copepoda	468	472		1,280	760	−52.0± 38.0	834	358	−47.6± 23.5
Ostracoda	1,342	1,645	30.3± 38.2	2,696	1,601	−109.5±107.0	915	682	−23.3± 29.6
Amphipoda	0	1		3	1		0	0	
Isopoda	0	0		2	1		0	0	
Hydracarina	15	23		53	38	−1.5± 2.0	35	19	−1.6± 0.9
Collembola	1	4		0	0		2	2	
Ephemeroptera	35	31		53	55		43	40	−0.3± 0.96
Anisoptera	8	8		5	3		11	11	
Zygoptera	25	18		33	25		16	20	
Hemiptera	31	24		29	16		19	14	
Coleoptera	21	14		24	33		94	60	−3.4± 2.8
Trichoptera	3	7		1	6		1	2	
Lepidoptera	4	2		6	6		6	15	
Culicini	0	3		1	1		3	4	
Anopheles	0	0		0	0		2	3	
Chironomidae	189	229	4.0± 4.5	222	284	6.2± 12.0	363	529	16.6± 19.4
Other Diptera	3	6		10	10		5	23	
Gastropoda	2	2		0	6		15	5	
Total	5,139	5,142	0.3±117.0	9,310	6,992	−231.8±351.0	5,272	5,508	23.6±116.1

[1] Exceeds 1-percent level of significance.

TABLE 6.—*Changes in the population of surface organisms in pond 3, the check for treated ponds 1 and 2, due to seasonal variation and errors in sampling as indicated by paired surface samples taken at intervals of 48 hours in alternate weeks*—Continued

Organism	Sixth treatment (Aug. 14-16, 1945)			Eighth treatment (Aug. 29-31, 1945)			Tenth treatment (Sept. 11-13, 1945)		
	Number of paired samples								
	10			9			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	0	2		5	13		1	1	
Turbellaria	1	0		7	0		74	9	−6.5± 4.4
Nematoda	2,176	1,749	−42.7± 48.6	Not counted			Not counted		
Rotatoria	137	74	−6.3± 4.1	121	40	[1] −9.0± 3.7	20	21	
Oligochaeta	1,561	2,473	91.2± 64.6	1,803	1,759	−4.9± 46.8	2,215	897	−131.8±112.5
Hirudinea	0	0		0	0		2	1	
Cladocera	2,055	2,054		3,777	3,013	−84.9±114.4	1,945	2,219	27.4± 68.2
Copepoda	1,769	1,087	−68.2± 56.5	2,033	1,181	−94.6± 49.8	547	1,001	45.4± 28.0
Ostracoda	637	344	[1] −29.3± 10.8	531	329	−22.4± 26.2	438	482	4.4± 15.6
Amphipoda	1	0		0	0		0	0	
Palaemonetes	0	0		0	0		0	1	
Hydracarina	16	23		119	64	−6.1± 3.0	107	173	6.6± 8.3
Collembola	1	3		7	0		0	14	
Ephemeroptera	79	58	−2.1± 2.2	98	32	−7.3± 5.0	143	96	−4.7± 6.0
Anisoptera	33	12		28	16	−1.3± 1.1	37	25	−1.2± 1.6
Zygoptera	13	19		25	13	−1.3± 1.6	33	18	−1.5± 0.8
Hemiptera	13	11		26	19	−0.8± 1.2	16	4	[1] −1.2± 0.5
Coleoptera	72	47	−2.5± 1.5	61	58		59	19	[1] −4.0± 1.7
Trichoptera	0	0		1	1		0	1	
Lepidoptera	1	0		1	3		2	2	
Culicini	3	0		2	3		0	3	
Anopheles	2	0		1	2		7	0	
Chironomidae	568	874	30.6± 36.7	1,772	1,033	−82.1± 55.6	1,478	740	−73.8± 58.8
Other Diptera	32	22		34	54	2.2± 1.6	483	129	−35.4± 33.6
Gastropoda	2	2		0	1				
Total	9,172	8,854	−31.8±151.5	10,452	7,634	−313.1±263.9	7,607	5,856	−175.1±269.5

[1] Exceeds 5-percent level of significance.

TABLE 6.—*Changes in the population of surface organisms in pond 3, the check for treated ponds 1 and 2, due to seasonal variation and errors in sampling as indicated by paired surface samples taken at intervals of 48 hours in alternate weeks*—Continued

Organism	Eleventh treatment (Sept. 18–20, 1945)			Thirteenth treatment (Oct. 2–5, 1945)			Fifteenth treatment (Oct. 17–19, 1945)		
	Number of paired samples								
	9			10			9		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	12	33	2.3± 1.4	138	132		4	1	
Turbellaria	32	21	−1.2± 1.9	19	3	−1.6± 1.4	4	1	
Nematoda	Not counted			Not counted			Not counted		
Rotatoria	17	33	1.8± 0.9	76	51	−2.5± 3.5	3	5	
Oligochaeta	1,185	1,537	39.1±60.3	2,552	1,354	−119.8±83.8	965	279	[1]−76.2 ±28.2
Cladocera	1,243	1,883	71.1±45.1	2,508	1,977	−53.1±70.9	507	264	−27.0±16.2
Copepoda	631	1,028	44.1±28.3	1,068	1,501	43.3±33.8	1,055	870	−20.5±21.5
Ostracoda	303	909	[1]67.3±19.8	1,153	913	−24.0±49.5	349	126	[1]−24.8± 8.0
Isopoda	1	0		0	0		0	0	
Hydracarina	40	90	5.6± 3.0	101	177	7.6± 7.3	87	46	−4.5± 2.6
Collembola	2	9		13	5		1	0	
Ephemeroptera	80	193	12.6± 5.5	353	229	−12.4±25.9	72	31	−4.5± 2.7
Anisoptera	14	30	1.8± 0.9	40	30	−1.0± 2.4	10	8	
Zygoptera	11	20		19	25		43	19	−2.7± 1.2
Hemiptera	17	27	1.1± 1.3	24	31		29	34	
Coleoptera	64	47	−1.9± 3.2	27	24		9	2	
Trichoptera	0	1		0	0		0	0	
Lepidoptera	1	0		2	3		1	0	
Culicini	2	1		3	2		1	0	
Anopheles	1	1		1	0		2	0	
Chironomidae	749	1,195	49.6±23.9	2,922	1,768	−115.4±134.7	697	409	−32.0±20.1
Other Diptera	261	145	−12.9±23.4	353	185	−16.8± 15.5	45	18	−3.0± 2.5
Gastropoda	3	5		0	1		3	0	
Total	4,669	7,208	[1]282.1±122.2	11,372	8,411	−296.1±397.9	3,887	2,113	[1]−197.1±71.6

[1] Exceeds 5-percent level of significance.

populations in the check and treated areas remained remarkably similar throughout the season. It is therefore concluded, on the basis of these data, that routine treatment at the rates of 0.1 pound of DDT

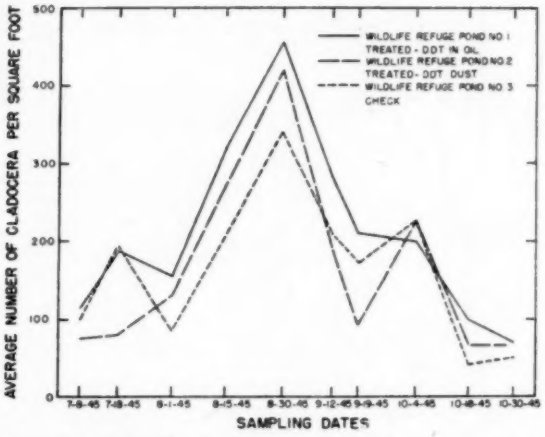

FIGURE 5.—A comparison of the seasonal abundance of Cladocera in an untreated pond with that in ponds routinely treated with DDT larvicides for 17 weeks. Treatments as indicated in figure 4. Graph based on 570 quantitative square-foot surface samples.

dust or 0.05 pound of DDT in fuel oil per acre have little or no effect on these organisms.

The effects of the two types of treatment on the population of surface insects in the ponds at the Wildlife Refuge are shown in figure 6. A comparison of the standing populations in the three ponds throughout the 17 weeks of treatment indicates a reduction in the number of surface insects in the treated ponds, with the larger reduc-

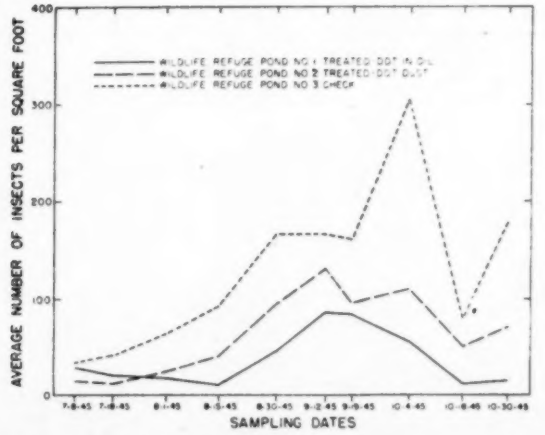

FIGURE 6.—A comparison of seasonal trends in the population of surface insects in check and treated ponds. Treatment for the various ponds as indicated in figure 4. Data from 570 quantitative square-foot surface samples.

tion occurring in the pond treated with a DDT-fuel-oil solution at the rate of 0.05 pound of DDT per acre. Most of this reduction occurred among the following orders of insects: Diptera, Coleoptera, Hemiptera, and Ephemeroptera. However, none of the orders were eliminated, and although individuals of these groups were not as abundant in the treated areas as they were in the check areas, the population in the treated areas did show a seasonal increase. From this data, it is concluded that the population of surface insects is kept at a level below their natural abundance by routine treatment, and that oil solutions are more toxic than dust.

The effect of the routine laviciding on surface aquatic insects was most pronounced on the chironomid population. Seasonal trends in the population of chironomids in the check and treated ponds are shown in figure 7, which indicates the average number of organisms taken per square foot in each of the ponds throughout the season. As in other instances, the greatest reduction occurred in the pond treated with a DDT-oil solution.

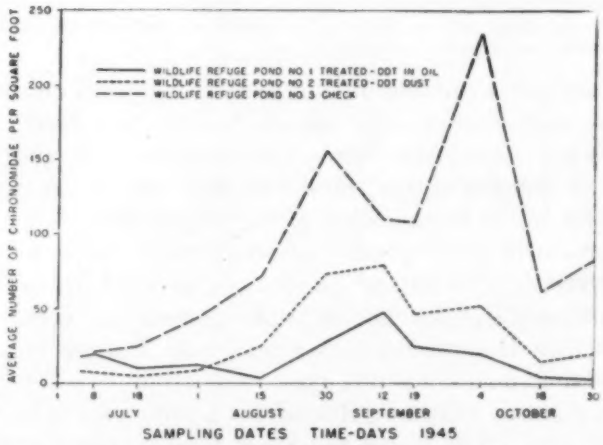

FIGURE 7.—The effects of routine larviciding with DDT on the population of Chironomidae as indicated by a comparison of the populations in check and treated areas throughout the period of treatment. Treatment as indicated in figure 4. Data based on 570 quantitative square-foot surface samples.

As has been shown previously (figure 4), the total population of surface forms increased in treated areas. This increase occurred in spite of a considerable decrease in the aquatic insects and was largely due to a significant increase in a few forms. In the treated ponds at the Wildlife Refuge, there was a considerable increase in the nematodes, oligochaetes and copepods. The seasonal abundance of oligochaetes in the check and treated ponds is compared in figure 8. Their increase in abundance in the treated ponds was rapid and significant, and suggests the limiting of some other forms of life by the DDT. It is

probable that the DDT reduced the predators or competitors of the oligochaetes nematodes, and copepods. The significance of this change from the standpoint of fish production is not definitely known,

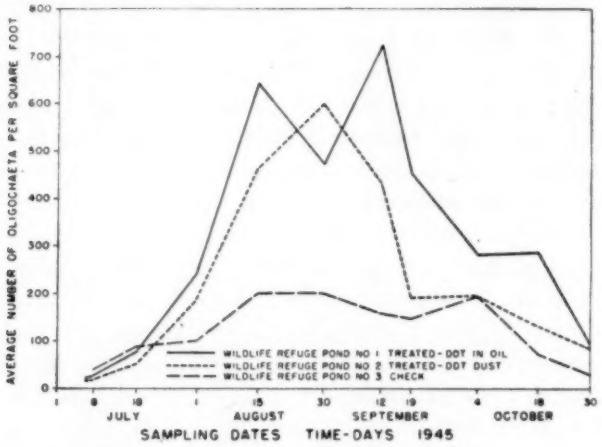

FIGURE 8.—A comparison of the abundance of Oligochaeta in untreated and treated areas during the period of 17 routine treatments with DDT larvicides. Treatments for the ponds as indicated in figure 4. Data based on 600 quantitative square-foot surface samples.

since data are not available on the relative value of chironomids, in contrast to oligochaetes and nematodes, as fish food. Although chironomids are much larger forms, the others occur in great numbers, and the total volume of food produced may not be greatly modified by the change in the composition of the population.

Studies made in other ponds indicated much the same changes as those observed in the Refuge ponds. In general, there was an increase in nematodes, oligochaetes, and copepods, a decrease in chironomids, surface Hemiptera, Coleoptera, and Ephemeroptera, while other forms remained about the same.

Test pond 4 was routinely dusted by a crew regularly engaged in mosquito control. Treatment began on April 4, 1945, and continued into October. A total of 26 applications were made with a dust containing 1 percent DDT and 99 percent pyrophyllite, applied at the average rate of about 0.2 pound of DDT per acre. The effects of the first 4 applications on the population of surface organisms, as indicated by some 120 random square-foot surface samples taken before and after the individual treatments, are summarized in table 7. In this table, the average number of each group of organisms taken before treatment, and the mean difference between the number taken before and after treatment, are shown. Decreases in the average number found after treatment are indicated by a minus sign. The standard error of the mean difference has been calculated for those groups judged to be of importance, and the t and P values determined.

TABLE 7.—*Changes in the population of surface organisms in test pond number 4 due to routine dusting with 0.2 pound of DDT per acre, as indicated by random quantitative samples taken before and after the first four treatments*

Organism	First treatment (Apr. 4, 1945)		Second treatment (Apr. 12, 1945)		Third treatment (Apr. 21, 1945)		Fourth treatment (May 1, 1945)	
	Average number before treatment	Mean difference after treatment, and its standard error	Average number before treatment	Mean difference after treatment, and its standard error	Average number before treatment	Mean difference after treatment, and its standard error	Average number before treatment	Mean difference after treatment, and its standard error
Hydra	34.7	0	34.7	[1] −26.9±10.6	7.8	0.6	8.3	−3.4
Turbellaria	2.1	−2.1	0		0		0	
Nematoda	321.3	315.7±236	637.0	−453.7±235.3	183.3	−58.1	125.1	−43.6
Rotatoria	5.0	−1.4	3.6	.9	4.5	−1.5	3.0	−1.8
Bryozoa	5.2	24.1	29.3	−23.6	5.6	4.0	9.7	4.0
Oligochaeta	287.5	86.9	374.0	−254.1±139.0	120.3	[1] 611.7±302	732.0	−276.4±320.5
Cladocera	7.7	[1] 10.7±4.7	18.4	−7.7±6.7	10.7	[1] 37.1±17.4	47.8	−15.6±19.0
Copepoda	36.6	−8.1	29.7	−5.0	23.5	[1] 57.0±26.9	80.5	−43.0±25.4
Ostracoda	13.5	−3.8	9.7	−4.6	5.1	146.8±81.2	151.9	−129.0±73.3
Hydracarina	2.0	1.0	3.0	4.4	7.4	−.1	7.2	−5.7
Collembola	.2	0	.2	−.2				
Ephemeroptera	7.6	−2.1	5.5	−3.6±2.5	2.0	3.8	5.7	−3.3
Anisoptera	1.7	1.0	2.6	−2.5	.2	.2	.4	.3
Zygoptera	1.0	−.7	.3	−.2	.1	.1	.2	−.1
Hemiptera	.3	−.2	.1	0	.1	0	.1	.7
Coleoptera	1.4	.3	1.7	−1.4	.3	2.8	3.0	−2.0
Trichoptera	.2	−.1	.1	−.1				.1
Lepidoptera	1.4	1.3	2.7	−1.3	1.4	.1	1.5	−1.2
Culicini	.1	.2	.3	−.3				
Anopheles		.1	.1	−.1			.1	
Chironomidae	102.1	−46.6±29.4	55.4	−18.2	37.2	107.6±65.7	144.8	−71.3±63.4
Other Diptera	78.2	13.0	91.1	−62.0±32.5	29.1	−9.6	19.5	−9.6±8.4
Gastropoda	7.6	11.3	18.8	−16.3	2.6	−.6	2.0	−1.3
Total	917.3	400.4±462	1,317.7	[1] −876.0±438.3	441.6	901.7±495	1,343.0	−601.8±487.0

[1] Exceeds 5-percent level of significance.

TABLE 8.—*Changes in the population of surface organisms in test pond number 4 due to routine dusting with 0.2 pound of DDT per acre, as indicated by paired quantitative square-foot surface samples taken just before, and 48 hours after, the indicated treatments*

Organism	Eighth treatment (May 28, 1945)			Tenth treatment (June 12, 1945)			Sixteenth treatment (July 27, 1945)		
	Number of paired samples								
	14			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After	
Hydra	0	0		0	1		0	0	
Nematoda	Not counted			474	118	−35.6± 22.0	439	758	31.9± 39.0
Rotatoria	13	7		2	0		0	0	
Bryozoa	178	13	−11.8± 8.0	35	26		0	0	
Oligochaeta	Not counted			9,073	10,058	98.5±220.5	18,934	883	−1,805.1±1,155.0
Cladocera	219	20	−14.2± 9.2	7	7		89	25	−6.4± 6.1
Copepoda	337	522	13.2± 7.8	174	258	8.4± 10.4	975	216	−75.9± 67.6
Ostracoda	523	1,385	61.6±33.6	3,111	2,438	−67.3±106.6	1,493	737	−75.6± 80.3
Amphipoda	0	0		0	1		0	0	
Isopoda	0	0		0	0		6	0	
Palaemonetes	0	0		0	0		0	1	
Hydracarina	1	11		6	2		12	7	
Collembola	0	2		31	62	3.1± 4.3	416	27	−38.9± 29.5
Ephemeroptera	23	41	1.3± 0.1	29	14	−1.5± 1.7	3	0	
Anisoptera	12	38		57	101	4.4± 3.4	32	13	
Zygoptera	1	9		3	26		30	31	
Hemiptera	9	8		9	4		4	5	
Coleoptera	10	20		6	13		43	27	
Trichoptera	0	1		0	0		0	0	
Lepidoptera	9	31	1.6± 0.9	82	121	3.9± 2.0	10	2	
Culicini	1	0		0	0		0	0	
Anopheles	0	0		0	0		0	17	
Chironomidae	355	518	11.6±21.9	705	827	12.2± 34.7	194	239	4.5± 12.0
Other Diptera	113	107	−0.4± 3.8	97	181	8.4± 8.4	17	25	
Gastropoda	30	147	8.4± 5.0	66	66		17	76	
Total	1,834	2,880	74.7±58.9	13,967	14,324	35.7±358.0	22,714	3,089	−1,962.5±1,290.8

A 5-percent level of significance has been selected as significant for changes after treatment. It will be noted (table 7) that although there was considerable variation in the numbers of the various groups of organisms taken before and after treatment, very few of the changes were significant and these were not consistent changes.

Changes due to the eighth, tenth, and sixteenth treatment in pond 4, as indicated by paired surface samples, are summarized in table 8. The mean numbers of organisms taken in 10 samples before and after treatment are shown, along with the differences between these means and the standard error of this difference, for those groups judged to be the most important or having the largest numbers of individuals. No significant changes were noted. Sampling was discontinued after the sixteenth treatment, due to the entrance of brackish water through a newly constructed drainage ditch.

Results of treatments in ponds 5 and 6 are summarized in table 9. These ponds were located in the Camp Stewart area and were small, temporary sand-bottom ponds, resulting from the overflow of the Canoochee River. Pond 5 was treated with a DDT-fuel-oil solution, to which was added 0.5 percent of B-1956 [5] in order to improve the spreading properties of the fuel oil. Some significant changes appear to have resulted from the three treatments. There was a significant decrease in total organisms after the first treatment, and a general decrease in the mayflies and midges, whereas the copepods, ostracods, and nematodes showed a distinct increase after the third treatment.

Emulsions were used for the larviciding in pond 6. The first application consisted of an emulsion made by adding 1 gallon of fuel oil, containing 0.1 pound of DDT and 0.5 percent of a spreading agent, to 14 gallons of water. Treatment was at the rate of 15 gallons of emulsion per acre for both the first and second treatments, but the amounts of oil and DDT were doubled for the second application. Surface Hemiptera and Coleoptera were killed by both treatments, and there was a marked decrease in the mayflies and chironomids. However, other forms, such as nematodes, oligochaetes, and copepods, increased to such an extent that there was a significant increase in the total population after the first treatment, and a considerable increase after the second.

Test pond No. 7 had a permanent inflow of water from a nearby artesian well. It was given weekly routine treatments at the rate of 0.1 pound of DDT and 1 gallon of fuel oil per acre. Treatment began early in July and was discontinued in December. The effects of the various individual treatments are summarized in table 10. Gross observations indicated that the first two applications killed a large number of Coleoptera and Hemiptera. Members of these

[5] B-1956 is a spreading agent manufactured by the Rohm & Haas Co. of Philadelphia, Pa.

TABLE 9.—*Changes in the population of surface organisms in two test ponds due to treatments with DDT larvicides, as shown by paired square-foot samples taken just before, and 48 hours after, each treatment*

Number of paired samples	8			7			10			10			4		
Dosage per acre	1 gallon fuel oil, 0.1 pound DDT			2 gallons fuel oil, 0.1 pound DDT			2 gallons fuel oil, 0.1 pound DDT			Emulsion: 14 gallons water, 1 gallon fuel oil, 0.1 pound DDT			Emulsion: 13 gallons water, 2 gallons fuel oil, 0.2 pound DDT		
	Pond No. 5									Pond No. 6					
Organism	First treatment (May 17, 1945)			Second treatment (May 24, 1945)			Third treatment (June 1, 1945)			First treatment (May 17, 1945)			Second treatment (May 25, 1945)		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After		Before	After		Before	After	
Hydra	6	0		0	3		0	0		1	4		1	1	
Nematoda	65	83	2.3± 3.6	77	89	1.7± 6.4	72	181	10.9± 6.0	258	389	13.1± 9.8	75	122	11.8±15.8
Oligochaeta	163	138	−3.1± 7.8	62	357	42.1±21.2	2,062	402	−166.0±81.8	417	634	21.7±18.5	81	109	7.0±24.5
Cladocera	184	130	−6.8± 5.9	104	207	14.7±10.7	210	237	2.7± 9.2	216	310	9.4± 4.6	66	75	2.3±12.6
Copepoda	547	637	11.3±16.8	545	890	49.3±40.1	705	1,856	[2] 115.1±33.5	698	1,949	[2] 125.1±30.1	806	1,029	55.8±35.2
Ostracoda	28	17		16	50	4.8± 2.7	116	598	[1] 48.2±17.4	202	166	−3.6±16.6	4	39	[1] 8.8± 2.3
Amphipoda	9	1		0	1		4	3		0	0		0	0	
Palaemonetes	6	5		4	4		4	15		3	8		8	2	
Hydracarina	6	6		5	2		11	13		71	58		30	36	1.5± 5.5
Ephemeroptera	82	23	[1] −7.4± 3.0	23	10	[1] −1.9± 0.6	7	15		65	24	−4.1± 2.1	6	3	
Anisoptera	15	3		2	2		1	2		5	4		0	4	
Zygoptera	10	4		3	7		8	21		4	9		3	16	
Hemiptera	6	3		2	2		6	16		6	5		0	0	
Coleoptera	7	4		4	5		2	3		3	6		0	1	
Trichoptera	1	0		0	0		0	0		0	0		0	0	
Lepidoptera	1	1		1	0		0	0		0	0		0	0	
Culicini	0	0		0	1		0	0		0	0		0	0	
Anopheles	0	2		2	0		0	0		0	0		0	0	
Chironomidae	625	68	−69.6±29.9	50	23	−3.9± 2.7	106	27	[1] −7.9± 3.4	329	58	[1] −27.1±10.1	22	4	−4.5± 4.5
Other Diptera	24	11		5	2		14	7		22	23		7	2	
Gastropoda	0	0		0	0		0	0		2	1		0	0	
Total	1,785	1,136	[1] −81.1±31.7	905	1,655	107.1±71.2	3,328	3,396	6.8±95.6	2,302	3,648	[2] 134.6±38.1	1,109	1,443	83.5±93.4

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

TABLE 10.—*Effects on the surface organisms in test pond No. 7 of the routine use of 0.1 pound of DDT in 1 gallon of fuel oil per acre, as shown by square-foot surface samples taken just before, and 48 hours after, each treatment*

Organism	First treatment (July 9, 1945)			Second treatment (July 17, 1945)			Fourth treatment (Aug. 1, 1945)			Sixth treatment (Aug. 14, 1945)			Eighth treatment (Aug. 28, 1945)		
	Number of paired samples														
	10			10			10			9			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After		Before	After		Before	After	
Turbellaria	0	1		0	0		0	0		0	0		0	0	
Nematoda	17	24		6	11		35	5	−3.0± 2.6	40	148	12.0± 9.0	Not counted		
Rotatoria	0	0		0	0		0	0		1	0		0	0	
Oligochaeta	22	32	1.0± 1.0	47	19	−2.8± 1.4	335	155	−18.0± 20.2	430	231	−22.1± 12.5	247	226	−2.1±10.3
Hirudinea	0	0		0	2		0	0		0	2		0	0	
Cladocera	2,389	1,895	−49.4± 99.1	2,028	1,770	−25.8±110.5	1,760	2,484	72.4± 72.8	2,054	130	−213.7±104.9	164	123	−4.1± 4.1
Copepoda	7,587	7,051	−53.6±252.5	6,288	5,426	−86.2±165.4	5,617	7,862	224.5±214.3	3,163	2,002	−129.0± 95.3	289	422	13.3± 6.1
Ostracoda	269	252	−1.7± 9.5	349	212	−13.7± 10.0	187	106	[1] −8.1± 3.6	287	118	−18.8± 12.1	108	183	7.5± 7.7
Hydracarina	23	14	−0.9± 1.0	45	11	−3.4± 2.0	19	23	0.4± 2.1	56	1	−6.1± 3.4	11	8	
Collembola	2	3		0	4		0	6		3	1		12	1	−1.1± 0.7
Ephemeroptera	20	10	−1.0± 0.9	26	9	−1.7 ± 0.9	17	5	−1.2± 1.2	32	2	−3.3± 3.1	1	0	
Anisoptera	68	58	−1.0± 1.9	63	50	−1.3± 2.4	100	65	−3.5± 2.7	48	13	[1] −3.9± 1.5	7	10	
Zygoptera	8	15		9	10		16	8	−0.8± 0.8	24	21		6	7	
Hemiptera	12	23		9	8		3	7		7	3		5	0	
Coleoptera	12	12		10	11		4	4		8	4		6	3	
Lepidoptera	6	3		3	1		2	0		2	0		0	0	
Culicini	9	3		9	0		4	0		0	0		0	0	
Anopheles	1	0		0	0		0	0		0	0		0	0	
Chironomidae	4,550	1,030	[2] −352.0± 88.2	710	104	−60.6± 32.1	607	130	[1] −47.7± 19.9	124	28	−10.7± 4.9	14	4	−1.0± 0.7
Other Diptera	82	46	−3.6± 1.8	17	19		70	10	[1] −6.0± 1.9	30	9	[1] −2.3± 0.9	36	21	−1.5± 1.4
Gastropoda	6	3		11	1		13	0	[1] −1.3± 0.5	8	9		9	18	
Total	15,083	10,475	−460.8±400.1	9,630	7,668	−196.2±299.1	8,789	10,870	208.1±275.4	6,317	2,722	−399.4±201.5	915	1,026	11.1±23.7

[1] Exceeds 5-percent level of significance.

[2] Exceeds 1-percent level of significance.

TABLE 10.—*Effects on the surface organisms in test pond No. 7 of the routine use of 0.1 pound of DDT in 1 gallon of fuel oil per acre, as shown by square-foot surface samples taken just before, and 48 hours after, each treatment*—Continued

Organism	Tenth treatment (Sept. 13, 1945)			Eleventh treatment (Sept. 19, 1945)			Thirteenth treatment (Oct. 2, 1945)			Fifteenth treatment (Oct. 15, 1945)			Seventeenth treatment (Oct. 29, 1945)		
	Number of paired samples														
	10			10			10			10			10		
	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error	Number of organisms		Mean difference and its standard error
	Before	After		Before	After		Before	After		Before	After		Before	After	
Turbellaria	0	0		1	0		0	0		0	1		7	2	−0.5
Nematoda	104	157	5.3± 8.2	Not counted			Not counted			Not counted			Not counted		
Rotatoria	0	0		3	0		0	0		0	0		0	0	
Oligochaeta	747	432	−31.5± 29.8	1,239	613	−62.6± 49.2	909	711	−19.8± 16.3	962	944	−1.8± 72.8	1,647	659	−98.8± 62.3
Hirudinea	0	0		0	0		0	0		1	0		0	0	
Cladocera	132	205	7.3± 7.5	149	57	−9.2± 7.3	413	587	17.4± 12.8	1,466	356	−111.0± 54.2	761	981	22.0± 36.0
Copepoda	558	1,713	115.5± 82.9	1,121	1,680	55.9± 68.7	5,856	7,838	198.2±242.1	7,407	2,527	[1]−488.0±169.4	4,039	3,850	−18.9± 99.9
Ostracoda	166	171	0.5± 3.9	146	215	6.9± 10.2	532	378	−15.4± 15.7	1,084	428	−65.6± 39.2	589	455	−13.4± 10.9
Isopoda	0	0		0	0		0	0		0	0		0	0	
Hydracarina	8	36	2.8± 1.6	24	6	−1.8± 1.2	23	54	3.1± 1.5	177	62	−11.5± 8.6	72	43	−2.9± 1.8
Collembola	3	6		23	28		44	153	10.9± 4.9	13	10		3	3	
Ephemeroptera	10	7		3	3		11	10		28	2	−2.5± 2.2	16	5	
Anisoptera	30	20		17	19		105	108		163	68	−9.5± 6.3	105	76	−2.9± 3.4
Zygoptera	8	14		21	11		22	18		18	9		21	25	
Hemiptera	4	5		1	1		4	6		1	0		0	0	
Coleoptera	5	6		6	7		3	6		17	6	−1.1± 1.1	2	3	
Trichoptera	0	0		0	0		0	0		1	0		0	0	
Lepidoptera	2	1		1	1		1	0		0	0		0	0	
Culicini	1	0		0	0		0	0		0	0		0	0	
Chironomidae	407	273	−13.4± 10.5	35	46	1.1± 1.5	114	112		89	53	−3.6± 2.9	11	7	
Other Diptera	61	25	−3.6± 2.1	490	208	−28.2± 18.4	215	178	−3.7± 7.4	127	61	−6.6± 5.6	30	23	−0.7
Gastropoda	61	34	−2.7± 2.2	138	27	−11.1± 8.1	46	24	−2.2± 1.7	217	67	−15.0± 8.7	207	339	13.2± 8.5
Total	2,307	3,105	79.8±121.7	3,418	2,922	−49.6±136.2	8,298	10,183	188.5±259.6	11,771	4,595	−717.6±324.7	7,510	6,471	−103.9±156.6

[1] Exceeds 5-percent level of significance.

orders were found dead after each of the 22 applications applied to the pond, indicating a reduction but not an elimination of surface forms. Surface sampling was discontinued after the seventeenth treatment. As indicated in table 10, few significant changes occurred due to individual treatments. However, long-term or cumulative effects were noted after treatment had continued for a number of weeks. The larger members of the families Gyrinidae, Dytiscidae, Haliplidae, Hydrophilidae, Corixidae and Gerridae became quite scarce after several treatments. Further, the quantitative surface samples indicated a reduction in Chironomidae and Ephemeroptera, whereas there was an increase in Oligochaeta. The seasonal trends of the population of oligochaetes, insects, and chironomids in a treated pond are shown graphically in figure 9. All insects, and chironomids in particular, were drastically reduced by the treatments with DDT, whereas the oligochaetes steadily increased. This change was observed in all ponds treated routinely.

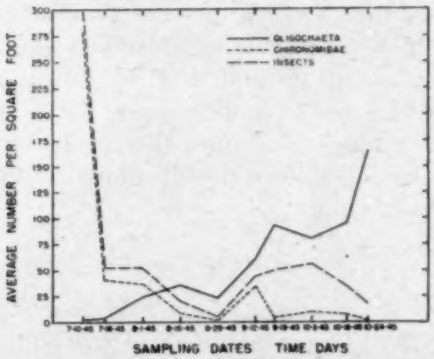

FIGURE 9.—Trends in the population of Oligochaeta, Chironomidae, and Insecta in a pond routinely treated for 17 weeks at the rate of 1 gallon fuel oil and 0.1 pound of DDT per acre. Graph based on 200 quantitative square-foot surface samples.

SUMMARY

Quantitative sampling of the surface forms and counts of dead organisms on the water surface 24 hours after treatment were the methods used for determining the effects of routine treatment with DDT larvicides.

Routine applications of DDT as a dust caused little apparent damage to the surface organisms, as indicated by gross observations. Paired square-foot surface samples, taken before and 48 hours after treatment, indicated few significant changes due to treatment. The seasonal trend of the population of surface organisms was somewhat affected by routine treatments with dust at the rate of 0.1 pound of DDT per acre, but the changes were not as great as those caused by treatments with solutions of DDT in fuel oil.

DDT-fuel-oil solutions killed the large surface insects, such as Dytiscidae, Gyrinidae, Hydrophilidae, and Corixidae, at concentrations as low as 0.025 pound of DDT per acre. However, the kills resulting from applications of 0.05 or 0.025 pound of DDT per acre were proportionately much less than those resulting from applications at the rate of 0.1 pound per acre. As was true for treatments with dust, few significant changes occurred due to any single treatment. The seasonal effects of routine DDT treatments, as indicated by a comparison of the population of surface organisms in the treated and check ponds, were quite marked. There was an increase in the number of Oligochaeta, Nematoda, and Copepoda, and a decrease in the Chironomidae, Hemiptera, Coleoptera, and Ephemeroptera. Insects as a group decreased in number in the treated ponds, with the largest decrease occurring among the Chironomidae.

The net results of these changes are difficult to evaluate, but it appears that there is some reduction in the available supply of fish food. Although the forms which increase in numbers often occur in great abundance, they are much smaller than the forms which are reduced in number, and in general they are not as readily taken by the fish. Reductions noted to date, however, have not been sufficient to affect the breeding stock, and since treatment is in localized areas, it is probably not sufficient to seriously limit the fish population by restriction of the food supply.

ACKNOWLEDGMENTS

Several members of the staff of Carter Memorial Laboratory were engaged in the study of the effects of DDT larviciding on the surface organisms. Mr. William Lynn assisted in the taking of the surface samples. Miss Kate Purvis, Mrs. B. B. Whitmarsh, Miss Marjorie Chaplin, and Mrs. Dorothy Coleman counted and recorded the various groups of organisms in the laboratory. Miss Rosetta Davis made the calculations and assisted in the preparation of the tables. The author wishes to express his appreciation to other members of the staff who have assisted in numerous ways, and especially to Dr. S. W. Simmons who made the study possible and actively encouraged and expedited the investigations.

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INCIDENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED MARCH 22, 1947

Summary

A total of 52,115 cases of influenza was reported for the week (exclusive of Kentucky, where special surveys showed 20,515 cases of upper respiratory infection), as compared with 42,997 last week, 3,477 for the corresponding week last year, and 14,953 for the week in 1939, the last named figure being the largest number reported for any corresponding week of the past 12 years. Declines were reported in only the West North Central and Mountain areas, resulting from decreased numbers reported in Kansas, Colorado, and Arizona. Of 19 States reporting more than 200 cases each, 16 showed an increase of 14,841, and 3 reported a decline of 5,436. Reports of 12 States, showing for the current week 565 or more cases each and aggregating 48,032, are as follows (last week's figures in parentheses): *Increases*—Iowa 2,321 (970), Virginia 1,439 (1,151), West Virginia 2,589 (2,099), South Carolina 1,814 (1,518), Georgia 1,019 (482), Alabama 1,847 (328), Arkansas 6,859 (5,306), Oklahoma 7,624 (1,083), Montana 565 (193); *decreases*—Kansas 1,947 (6,260), Texas 19,087 (19,527), Colorado 921 (1,604). The total for the year to date is 157,694, as compared with 173,413 for the same period last year and a 5-year (1942–46) median of 57,807. During the 4 weeks ended with the current week, a total of 125,077 cases has been reported, as compared with 18,400 for the corresponding period last year, a 5-year median of 17,615, and 63,297, the largest number for any corresponding period of the past 12 years (in 1939).

Of 31 cases of poliomyelitis, 2 less than reported for last week (which was the average week of lowest seasonal incidence) 12 occurred in California. The total for the year to date is 656, as compared with 493 for the same period last year and a 5-year median of 320.

Both the current and cumulative figures for diphtheria, measles, meningococcus meningitis, scarlet fever, smallpox, typhoid and paratyphoid fever, and typhus fever are below the respective corresponding 5-year medians.

Deaths recorded for the week in 93 large cities of the United States totaled 10,225, as compared with 10,310 last week, 9,569 and 9,640, respectively, for the corresponding weeks of 1946 and 1945, and a 3-year (1944–46) median of 9,605. The cumulative figure is 120,684, as compared with 123,115 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended Mar. 22, 1947, and comparison with corresponding week of 1946 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none was reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946	
NEW ENGLAND												
Maine	2	6	1	----	5	2	148	24	24	0	1	2
New Hampshire	0	0	0	2	2	1	6	4	10	2	0	0
Vermont	0	1	0	11	----	----	220	16	39	0	0	0
Massachusetts	22	3	3	----	----	----	376	761	782	0	6	8
Rhode Island	1	2	1	1	1	----	173	4	31	0	1	2
Connecticut	0	1	1	2	3	2	642	185	349	1	3	4
MIDDLE ATLANTIC												
New York	18	14	15	[1] 10	[1] 3	[1] 6	424	4,221	2,413	9	22	32
New Jersey	10	4	4	22	5	10	432	2,591	1,515	1	3	5
Pennsylvania	10	21	10	----	3	3	321	3,949	1,206	12	8	12
EAST NORTH CENTRAL												
Ohio	8	18	11	74	4	14	817	571	571	2	6	7
Indiana	13	14	7	179	10	10	48	1,098	262	2	5	5
Illinois	5	54	14	475	30	30	93	1,802	1,092	4	9	10
Michigan [2]	4	11	10	4	1	3	31	3,032	904	5	2	11
Wisconsin	0	5	5	537	70	55	291	1,791	1,260	1	1	3
WEST NORTH CENTRAL												
Minnesota	6	7	5	----	----	1	32	45	121	3	3	3
Iowa	2	5	4	2,321	----	----	29	133	239	2	6	0
Missouri	7	2	4	378	3	3	14	340	414	9	5	6
North Dakota	2	0	0	190	6	9	15	22	61	0	0	0
South Dakota	3	0	2	17	----	----	11	50	50	0	0	0
Nebraska	2	3	3	116	8	8	21	304	239	0	0	0
Kansas	6	4	4	1,947	2	4	7	1,121	760	3	2	5
SOUTH ATLANTIC												
Delaware	0	0	0	----	----	----	1	44	29	2	1	1
Maryland [2]	8	13	3	23	7	6	22	453	453	2	5	5
District of Columbia	0	0	0	5	----	1	27	214	91	1	5	2
Virginia	5	5	5	1,439	193	442	299	687	687	3	8	10
West Virginia	2	6	3	2,589	----	8	34	86	86	1	3	3
North Carolina	8	14	8	----	----	7	248	482	482	2	0	9
South Carolina	0	3	3	1,814	539	515	128	433	259	1	0	2
Georgia	3	1	5	1,019	261	79	181	306	298	1	0	3
Florida	3	1	2	73	4	4	8	130	130	3	2	3
EAST SOUTH CENTRAL												
Kentucky	11	10	4	[4] ----	47	19	7	596	106	0	5	5
Tennessee	15	6	6	550	33	50	115	283	218	3	5	8
Alabama	7	6	6	1,847	124	124	113	141	342	4	8	8
Mississippi [2]	5	13	2	354	----	----	21	----	----	2	1	6
WEST SOUTH CENTRAL												
Arkansas	5	5	5	6,859	109	109	212	172	172	1	3	3
Louisiana	5	16	6	85	88	47	42	233	197	3	10	6
Oklahoma	5	8	5	7,624	125	125	----	182	89	3	1	1
Texas	20	40	37	19,087	1,504	1,049	216	1,867	1,867	6	8	8
MOUNTAIN												
Montana	3	1	1	565	----	17	136	26	53	0	1	1
Idaho	0	0	0	147	26	3	9	150	92	1	0	0
Wyoming	0	0	0	25	1	20	11	36	71	1	1	0
Colorado	7	8	8	921	29	29	43	637	367	0	0	0
New Mexico	2	2	1	12	4	4	61	9	33	0	0	0
Arizona	4	1	1	86	133	137	30	105	105	0	1	0
Utah [3]	0	0	0	81	1	29	3	655	266	0	1	0
Nevada	0	0	0	3	----	----	1	13	13	0	0	0
PACIFIC												
Washington	11	8	2	353	----	5	54	806	291	3	5	5
Oregon	0	1	1	241	----	30	32	403	144	0	0	1
California	27	25	24	27	93	91	214	3,087	2,584	7	9	20
Total	277	368	27	52,115	3,477	3,477	6,429	34,300	24,632	106	166	225
12 weeks	3,510	4,611	3,713	157,694	173,413	57,807	62,501	186,541	184,225	1,039	2,399	3,013
Seasonal low week [3]	27th	July 5–11		(30th) July 26–Aug. 1			(35th) Aug. 30–Sept. 5			(37th) Sept. 13–19		
Total since low	11,076	16,255	12,509	190,669	535,661	93,669	85,388	212,665	222,238	2,011	3,903	5,418

[1] New York City only.
[2] Dates between which the approximate low week ends. The specific date will vary from year to year.
[3] Period ended earlier than Saturday.
[4] 20,515 cases of upper respiratory infection were reported, some of which were probably influenza.

Telegraphic morbidity reports from State health officers for the week ended Mar. 22, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [4]		
	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946		Mar. 22, 1947	Mar. 23, 1946	
NEW ENGLAND												
Maine	1	0	0	15	33	33	0	0	0	2	0	0
New Hampshire	0	0	0	11	3	13	0	0	0	0	0	0
Vermont	0	1	0	12	2	10	0	0	0	0	0	0
Massachusetts	0	0	0	140	199	388	0	0	0	3	5	1
Rhode Island	0	0	0	8	3	16	0	0	0	0	0	0
Connecticut	0	0	0	36	62	78	0	0	0	0	0	0
MIDDLE ATLANTIC												
New York	0	5	2	415	684	646	0	0	0	3	0	5
New Jersey	0	1	0	145	135	174	0	0	0	2	0	1
Pennsylvania	2	2	2	231	451	603	0	0	0	2	2	3
EAST NORTH CENTRAL												
Ohio	0	2	0	469	409	409	0	0	1	1	3	2
Indiana	0	1	0	136	108	137	0	1	1	1	1	3
Illinois	3	1	1	175	254	311	0	0	1	1	1	1
Michigan [2]	0	0	0	169	149	283	0	0	0	1	0	2
Wisconsin	0	0	0	97	169	294	0	0	0	1	2	1
WEST NORTH CENTRAL												
Minnesota	0	0	0	7	49	95	0	0	0	0	0	0
Iowa	0	0	0	53	67	79	0	2	0	0	0	0
Missouri	1	0	0	64	55	110	0	0	0	0	1	2
North Dakota	4	0	0	13	15	23	0	0	0	0	0	0
South Dakota	0	0	0	15	11	18	0	0	0	0	0	0
Nebraska	3	0	0	43	32	54	2	0	0	0	0	0
Kansas	0	0	1	32	74	96	0	0	0	0	0	0
SOUTH ATLANTIC												
Delaware	0	0	0	14	9	15	0	0	0	0	0	0
Maryland [2]	0	0	0	55	103	107	0	0	0	0	0	0
District of Columbia	0	0	0	6	25	25	0	0	0	0	1	0
Virginia	1	0	0	53	121	121	0	0	0	1	0	1
West Virginia	0	0	0	10	30	39	0	0	0	0	0	1
North Carolina	0	0	0	35	51	26	0	0	0	0	2	2
South Carolina	0	0	0	5	14	9	0	0	0	3	0	0
Georgia	0	0	0	8	6	14	0	1	0	0	5	3
Florida	0	1	0	14	4	4	0	0	0	1	0	1
EAST SOUTH CENTRAL												
Kentucky	0	1	0	56	41	55	0	0	0	1	0	0
Tennessee	0	0	0	72	36	47	0	0	0	0	0	1
Alabama	0	1	1	30	25	17	0	0	0	0	0	1
Mississippi [2]	0	2	0	15	6	16	0	0	0	0	1	1
WEST SOUTH CENTRAL												
Arkansas	1	0	0	1	14	15	0	1	1	0	1	1
Louisiana	1	1	0	2	9	11	1	1	0	0	5	3
Oklahoma	0	0	0	14	18	17	0	0	1	0	1	1
Texas	1	1	4	38	61	61	0	0	0	2	6	6
MOUNTAIN												
Montana	0	1	0	6	10	10	0	0	0	0	0	0
Idaho	0	0	0	11	4	6	0	0	0	0	0	0
Wyoming	0	0	0	4	17	17	0	0	0	0	0	0
Colorado	0	0	0	61	43	57	0	0	0	2	0	0
New Mexico	0	1	0	2	17	14	1	0	0	0	0	1
Arizona	0	0	0	7	17	17	0	0	0	1	1	0
Utah [2]	0	0	0	20	47	47	0	0	0	0	1	0
Nevada	0	0	0	0	1	1	0	0	0	0	0	0
PACIFIC												
Washington	1	1	1	59	27	53	0	7	0	5	2	1
Oregon	0	0	0	15	17	19	0	0	0	0	0	0
California	12	4	3	143	174	200	0	1	0	3	2	2
Total	31	27	24	3,103	3,877	4,290	4	14	14	36	43	53
12 weeks	656	493	320	32,977	40,402	48,344	49	99	152	521	518	674
Seasonal low week [3]	(11th) Mar. 15–21			(32nd) Aug. 9–15			(35th) Aug. 30–Sept. 5			(11th) Mar. 15–21		
Total since low	31	27	24	59,663	78,973	87,440	103	175	269	36	43	53

[2] Period ended earlier than Saturday.
[3] Dates between which the approximate low week ends. The specific date will vary from year to year.
[4] Including paratyphoid fever reported separately, as follows: Maine 1; Massachusetts 3 (salmonella infection); New York 1; Michigan 1; Colorado 1; Washington 2; California 1.

Telegraphic morbidity reports from State health officers for the week ended Mar. 22, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Whooping cough			Week ended Mar. 22, 1947							
	Week ended—		Median 1942–46	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	Mar. 22, 1947	Mar. 23, 1946		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	11	30	37								
New Hampshire	8		1	1							
Vermont	17	41	41								4
Massachusetts	171	100	232	1	3		1		1		
Rhode Island	14	36	36								
Connecticut	54	65	57								4
MIDDLE ATLANTIC											
New York	177	143	232	13	3						1
New Jersey	118	177	177								2
Pennsylvania	202	138	197								1
EAST NORTH CENTRAL											
Ohio	108	48	167								2
Indiana	46	17	17		1		3		1		3
Illinois	52	64	64	1					1	1	7
Michigan [1]	166	119	119								1
Wisconsin	107	95	95						1		7
WEST NORTH CENTRAL											
Minnesota	7	5	21								2
Iowa	18	18	18								15
Missouri	22	7	20						2		1
North Dakota			2								
South Dakota		1	1								
Nebraska	15		10								
Kansas	6	19	32								5
SOUTH ATLANTIC											
Delaware	4	2	3								
Maryland [1]	67	9	42								
District of Columbia	4	7	8								
Virginia	75	21	48			118			1		2
West Virginia	13	31	23								
North Carolina	36	59	152							2	
South Carolina	24	75	57	1	6					2	1
Georgia	8	11	19	1	4				11	6	4
Florida	25	11	20	4					1	9	2
EAST SOUTH CENTRAL											
Kentucky	9	20	31							1	
Tennessee	34	27	27				1		3		1
Alabama	67	6	25						5	6	4
Mississippi [1]	11									1	1
WEST SOUTH CENTRAL											
Arkansas	14	2	8	1	1				2		
Louisiana	3	2	2							2	
Oklahoma	14	5	12		2			1	1		
Texas	549	194	194	13	291	8				5	11
MOUNTAIN											
Montana		2	5								
Idaho	3	9	4					1			
Wyoming		2	7								
Colorado	21	39	32								1
New Mexico	1	11	8								1
Arizona	9	17	31			17	1				
Utah [1]	5	15	39								2
Nevada											
PACIFIC											
Washington	42	28	28	2							
Oregon	32	4	14	1							
California	191	90	319	3	3		1				8
Total	2,580	1,822	2,951	42	314	143	7	2	30	35	93
Same week, 1946	1,822			37	264	100	3	1	24	43	98
Median, 1942–46	2,951			35	194	45	11	0	14	38	[4] 95
12 weeks: 1947	30,499			546	4,054	2,679	81	12	468	543	1,205
1946	21,802			459	3,459	1,312	97	5	251	576	823
Median, 1942–46	29,090			324	2,462	745	97	4	226	576	[4] 919

[1] Period ended earlier than Saturday.

[4] 2-year average, 1945–46.

Anthrax: New Jersey 1 case.

WEEKLY REPORTS FROM CITIES [1]

City reports for week ended March 15, 1947

This table lists the reports from 88 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	----	0	50	0	1	0	2	0	0	3
New Hampshire:												
Concord	0	0	----	0	----	0	0	0	2	0	0	----
Vermont:												
Barre	0	0	----	0	26	0	0	0	0	0	0	----
Massachusetts:												
Boston	16	0	----	0	44	0	8	0	20	0	1	39
Fall River	0	0	----	0	5	0	0	0	2	0	0	9
Springfield	0	0	----	0	10	0	1	0	4	0	0	7
Worcester	0	0	----	0	2	0	7	0	7	0	0	31
Rhode Island:												
Providence	0	1	----	0	178	0	1	0	5	0	0	9
Connecticut:												
Bridgeport	0	0	----	0	11	0	1	0	5	0	0	----
Hartford	0	0	----	0	50	0	2	0	2	0	0	1
New Haven	0	0	----	0	25	0	4	0	5	0	0	6
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	1	0	1	0	8	0	12	0	1	2
New York	9	1	9	1	172	5	78	0	145	0	1	58
Rochester	0	0	----	0	1	0	6	0	10	0	0	2
Syracuse	0	0	----	0	----	1	2	0	6	0	0	11
New Jersey:												
Camden	5	0	----	0	----	0	0	0	1	0	0	----
Newark	0	0	3	0	8	0	4	0	16	0	0	18
Trenton	0	0	----	0	19	0	1	0	3	0	0	----
Pennsylvania:												
Philadelphia	2	0	3	1	27	1	22	0	36	0	0	34
Pittsburgh	0	0	6	0	64	1	7	0	24	0	0	8
Reading	0	0	----	0	2	0	0	0	6	0	0	3
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	1	0	----	0	----	0	7	0	10	0	0	3
Cleveland	1	0	9	0	412	1	3	0	26	0	0	14
Columbus	1	0	----	0	1	0	3	0	7	0	0	9
Indiana:												
Fort Wayne	0	0	----	0	18	0	4	0	7	0	0	----
Indianapolis	0	1	----	1	4	0	10	0	32	0	1	19
South Bend	0	0	2	0	----	0	0	0	1	0	0	----
Terre Haute	0	0	1	0	1	0	1	0	2	0	0	----
Illinois:												
Chicago	0	0	33	2	17	2	47	1	56	0	0	36
Michigan:												
Detroit	1	1	3	0	7	2	11	0	64	0	1	117
Flint	0	0	----	0	----	0	5	0	1	0	0	----
Grand Rapids	0	0	----	0	1	0	4	0	10	0	0	9
Wisconsin:												
Kenosha	0	0	----	0	----	0	0	0	2	0	0	7
Milwaukee	0	0	----	0	8	0	5	0	21	0	0	30
Racine	0	0	----	0	1	0	0	0	4	0	0	7
Superior	0	0	36	0	----	0	2	0	0	0	0	----
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	----	0	----	1	0	0	0	0	0	1
Minneapolis	1	0	----	0	14	0	7	1	9	0	0	4
Missouri:												
Kansas City	0	0	33	2	1	0	14	0	12	0	1	2
St. Joseph	0	0	----	0	----	0	1	0	0	0	0	6
St. Louis	3	0	126	6	10	3	40	0	7	0	0	----

[1] In some instances the figures include nonresident cases.

City reports for week ended March 15, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
Nebraska:												
Omaha	0	0	----	4	----	0	8	0	1	0	0	----
Kansas:												
Topeka	0	0	1	0	1	0	0	0	1	0	0	6
Wichita	0	0	1	0	1	0	7	0	3	0	0	----
SOUTH ATLANTIC												
Delaware:												
Wilmington	1	0	----	0	1	0	0	0	5	0	0	----
Maryland:												
Baltimore	7	0	1	1	5	0	13	1	20	0	0	74
Cumberland	0	0	----	0	----	0	2	0	1	0	0	----
Frederick	0	0	----	0	----	0	0	0	0	0	0	----
District of Columbia:												
Washington	0	0	4	0	24	0	8	0	16	0	0	6
Virginia:												
Lynchburg	0	0	----	0	2	0	1	0	2	0	0	----
Richmond	0	0	1	1	81	0	9	0	1	0	0	----
Roanoke	0	0	----	0	2	0	0	0	7	0	0	2
West Virginia:												
Charleston	0	0	----	0	1	0	0	0	1	0	0	----
Wheeling	0	0	----	0	----	0	4	0	0	0	0	----
North Carolina:												
Raleigh	0	0	----	0	----	1	0	0	0	0	0	4
Wilmington	0	0	----	0	16	0	2	0	0	0	0	----
Winston Salem	0	0	----	0	41	0	3	0	2	0	0	2
South Carolina:												
Charleston	0	0	7	0	4	0	1	0	0	0	0	1
Georgia:												
Atlanta	0	0	217	0	9	0	5	0	1	0	0	1
Brunswick	0	0	----	0	----	0	0	0	0	0	0	----
Savannah	0	0	6	0	46	0	4	0	0	0	0	----
Florida:												
Tampa	1	0	----	0	1	1	4	0	6	0	0	1
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	0	0	----	2	3	0	10	0	4	0	0	8
Nashville	0	0	----	0	----	0	3	0	9	0	0	2
Alabama:												
Birmingham	0	0	26	0	19	0	7	0	2	0	1	----
Mobile	0	0	3	1	20	0	1	0	1	0	0	2
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	7	0	4	1	0	0	1	0	0	1
Louisiana:												
New Orleans	10	0	6	0	55	5	9	2	3	0	2	----
Shreveport	0	0	----	0	----	0	1	0	0	0	0	----
Oklahoma:												
Oklahoma City	0	0	71	0	1	0	4	0	7	0	0	4
Texas:												
Dallas	0	0	5	1	16	0	9	0	2	0	0	13
Galveston	1	0	----	0	----	1	0	0	0	0	0	----
Houston	3	0	----	1	----	0	5	0	2	0	0	1
San Antonio	1	0	34	8	8	0	10	0	0	0	0	----
MOUNTAIN												
Montana:												
Billings	0	0	----	0	----	0	1	0	0	0	0	----
Great Falls	0	0	----	0	76	0	1	0	0	0	0	----
Helena	0	0	----	0	1	0	2	0	0	0	0	----
Missoula	0	0	----	0	----	0	1	0	0	0	0	----
Idaho:												
Boise	0	0	----	0	----	0	1	0	1	0	0	2
Colorado:												
Denver	2	0	14	1	17	0	7	0	25	0	0	1
Pueblo	0	0	----	0	----	0	6	0	6	0	0	----
Utah:												
Salt Lake City	0	0	----	0	5	0	1	0	4	0	0	1

City reports for week ended March 15, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	0	0	-----	0	2	1	2	0	11	0	0	-----
Spokane	0	0	-----	0	7	0	4	0	2	0	0	2
Tacoma	0	0	-----	0	5	1	0	0	0	0	0	-----
California:												
Los Angeles	4	0	3	0	5	2	3	0	30	0	0	25
Sacramento	0	0	-----	0	1	0	6	1	2	0	0	3
San Francisco	2	0	2	0	10	0	6	0	14	0	1	-----
Total	72	4	674	33	1,680	30	488	6	777	0	10	667
Corresponding week, 1946*	78	-----	105	30	11,233	-----	379	-----	1,105	4	10	410
Average 1942-46*	67	-----	148	[2] 32	[3] 6,292	-----	[2] 435	-----	1,733	1	11	714

[2] 3-year average, 1944-46.
[3] 5-year median, 1942-46.
*Exclusive of Oklahoma City.

Dysentery, amebic.—Cases: New York 6; Chicago 4.
Dysentery, bacillary.—Cases: Worcester 1; New York 2.
Dysentery, unspecified.—Cases: Baltimore 1; Richmond 1; Little Rock 1; Houston 1; San Antonio 2.
Tularemia.—Cases New Orleans 4.
Typhus fever, endemic.—Cases: Charleston, S. C., 1 (imported from Cuba); Tampa 1; New Orleans 4.

Rates (annual basis) per 100,000 population, by geographic groups, for the 88 cities in the preceding table (latest available estimated population, 1943, 34,250,600)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	41.8	2.6	0.0	0.0	1,048	0.0	65.3	0.0	141	0.0	2.6	274
Middle Atlantic	7.4	0.5	10.2	0.9	136	3.7	59.2	0.0	120	0.0	0.9	63
East North Central	2.5	1.2	51.5	1.8	288	3.1	62.6	0.6	149	0.0	1.2	154
West North Central	9.0	0.0	362.8	27.0	61	9.0	173.5	2.3	74	0.0	2.2	43
South Atlantic	14.7	0.0	385.7	3.3	381	3.3	91.5	1.6	101	0.0	0.0	149
East South Central	0.0	0.0	171.2	17.7	248	0.0	123.9	0.0	94	0.0	5.9	71
West South Central	38.1	0.0	312.4	25.4	213	17.8	96.5	5.1	38	0.0	5.1	48
Mountain	15.9	0.0	111.2	7.9	786	0.0	158.9	0.0	286	0.0	0.0	32
Pacific	9.5	0.0	7.9	0.0	47	6.3	33.2	1.6	93	0.0	1.6	47
Total	11.0	0.6	102.9	5.0	256	4.6	74.5	0.9	119	0.0	1.5	102

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended March 1, 1947.—During the week ended March 1, 1947, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		41	5	327	348	32	22	94	126	995
Diphtheria		1		20	3	2	1			27
Dysentery, amebic					1					1
Encephalitis, infectious					1					1
German measles		1		39	87	3	2	26	5	163
Influenza		98			25				128	251
Measles		105	23	124	172	421	80	245	519	1,689
Meningitis, meningococcus				2				1		3
Mumps		4		174	549	111	130	35	177	1,180
Poliomyelitis					2					2
Scarlet fever	2	3	5	90	77	4		5	12	198
Tuberculosis (all forms)		7	12	166	22	13		32		252
Typhoid and paratyphoid fever		1		5	1		1		1	9
Undulant fever				1	1			1		3
Venereal diseases:										
Gonorrhea	2	20	9	106	92	36	26	44	67	402
Syphilis	3	2	4	73	75	8	15	8	47	235
Other forms									4	4
Whooping cough		19		40	115	27	3	4	27	235

CUBA

Habana—Communicable diseases—4 weeks ended February 22, 1947.—During the 4 weeks ended February 22, 1947, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Chickenpox	3		Poliomyelitis	2	
Diphtheria	23	1	Tuberculosis	6	6
Malaria	1		Typhoid fever	74	2
Measles	20				

Provinces—Notifiable diseases—4 weeks ended February 22, 1947.—During the 4 weeks ended February 22, 1947, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana [1]	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer	8	16	17	19		19	79
Chickenpox		3			1	1	5
Diphtheria	1	26	3			1	31
Hookworm disease		13		1			14
Leprosy		6				2	8
Malaria	5	2		2	5	55	69
Measles	12	24	1		3	2	42
Poliomyelitis	2	3		1	1	4	11
Tuberculosis	60	38	14	40	14	29	195
Typhoid fever	6	103	7	10	3	47	176
Undulant fever					1		1
Whooping cough	1	11			1	1	14
Yaws						1	1

[1] Includes the city of Habana.

JAPAN

Notifiable diseases—4 weeks ended February 22, 1947, and accumulated totals for the year to date.—For the 4 weeks ended February 22, 1947, and for the year to date, certain notifiable diseases have been reported in Japan as follows:

Disease	4 weeks ended February 22, 1947		Total reported for the year to date	
	Cases	Deaths	Cases	Deaths
Diphtheria	2,662	307	5,472	569
Dysentery, unspecified	229	45	461	111
Encephalitis, Japanese "B"			1	2
Gonorrhea	14,306		26,062	
Malaria	581	4	1,216	5
Meningitis, epidemic	282	82	435	112
Paratyphoid fever	185	15	409	26
Scarlet fever	175	7	357	8
Smallpox	49	6	116	11
Syphilis	9,634		16,525	
Typhoid fever	828	141	1,928	251
Typhus fever	155	17	395	30

NORWAY

Notifiable diseases—November 1946.—During the month of November 1946, cases of certain notifiable diseases were reported in Norway as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	11	Paratyphoid fever	15
Diphtheria	261	Pneumonia (all forms)	1,927
Dysentery, unspecified	5	Poliomyelitis	63
Encephalitis, epidemic	9	Rheumatic fever	150
Erysipelas	563	Scabies	5,807
Gastroenteritis	2,865	Scarlet fever	646
Gonorrhea	915	Syphilis	160
Hepatitis, epidemic	564	Tuberculosis (all forms)	420
Impetigo contagiosa	4,859	Typhoid fever	7
Influenza	2,650	Undulant fever	1
Malaria	2	Weil's disease	2
Measles	150	Whooping cough	2,766
Mumps	281		

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-mentioned diseases, except yellow fever, during recent months. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday in each month.

Plague

Union of South Africa.—For the week ended March 8, 1947, 7 cases of plague were reported in the Union of South Africa, no specific location being given.

Smallpox

Egypt—Alexandria.—For the week ended February 22, 1947, 12 cases of smallpox were reported in Alexandria, Egypt.

France—Paris.—For the week ended March 15, 1947, 6 cases of smallpox with 1 death were reported in Paris, France, making a total of 11 cases and 1 death since March 1.

India—Calcutta.—Smallpox has been reported in Calcutta, India, as follows: Weeks ended—February 22, 1947, 84 cases, 59 deaths; March 1, 1947, 86 cases, 64 deaths.

DEATHS DURING WEEK ENDED MAR. 15, 1947

[From the Weekly Mortality Index, issued by the National Office of Vital Statistics]

	Week ended Mar. 15, 1947	Corresponding week, 1946
Data for 93 large cities of the United States:		
Total deaths	10,310	9,267
Median for 3 prior years	9,532	
Total deaths, first 11 weeks of year	110,460	113,546
Deaths under 1 year of age	777	590
Median for 3 prior years	663	
Deaths under 1 year of age, first 11 weeks of year	9,010	6,671
Data from industrial insurance companies:		
Policies in force	67,430,187	67,189,619
Number of death claims	12,148	15,222
Death claims per 1,000 policies in force, annual rate	9.4	11.8
Death claims per 1,000 policies, first 11 weeks of year, annual rate	9.8	11.4

* * *

FEDERAL SECURITY AGENCY

UNITED STATES PUBLIC HEALTH SERVICE

THOMAS PARRAN, *Surgeon General*

DIVISION OF PUBLIC HEALTH METHODS

G. ST. J. PERROTT, *Chief of Division*

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It contains (1) current information regarding the incidence and geographic distribution of communicable diseases in the United States, insofar as data are obtainable, and of cholera, plague, smallpox, typhus fever, yellow fever, and other important communicable diseases throughout the world; (2) articles relating to the cause, prevention, and control of disease; (3) other pertinent information regarding sanitation and the conservation of the public health.

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